Expert Report of
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Prepared on Behalf of the
Idaho Ground Water Appropriators, Inc.

In the Matter of the Petition of Delivery Call of A&B Irrigation District for the Delivery of Ground Water and for the Creation of a Ground Water Management Area

(Exhibit 400)

July 16, 2008

SPF Water Engineering, LLC
water resource consultants

Executive Summary

A&B is seeking administration of junior-priority ground-water rights and designation of the Eastern Snake Plain Aquifer (ESPA) as a Ground Water Management Area (GWMA). A&B claims that it is suffering material injury as a result of reduced ground-water diversions caused by the decreasing ground-water pumping levels within the Eastern Snake Plain Aquifer (ESPA).

A review of information and data pertinent to the A&B delivery call led to the following conclusions:

1. Diversion of less than 1,100 cfs and 250,417.2 acre feet per year has been sufficient for the intended beneficial use under water right 36-2080 and does not represent injury.
2. No evidence has been provided quantifying fallow acreage, a shift to lower-demand crops, or reduced crop yields. On the contrary, irrigated acreage has increased and crops grown in the B-Unit are the same as the surface-water irrigated A-unit. Based on the evidence provided, the A&B Irrigation District is not water short.
3. Sufficient delivery – despite withdrawal less than the maximum amounts authorized under water right 36-2080 – has been made possible by increased irrigation efficiency, increased conveyance efficiency, direct hookups from wells to irrigation systems, and abandonment of injection wells. Similar efficiency improvements have occurred throughout much of the Eastern Snake River Plain to improve water delivery to crops and reduce labor costs.
4. A&B uses an internal delivery standard of 0.75 inches per acre. However, a delivery rate of 5/8 (0.625) inch per acre has been deemed appropriate for other nearby irrigation entities (e.g., American Falls Reservoir District #2, the North Side Canal Company, and the Twin Falls Canal Company) with similar irrigation requirements.
5. Additional wells and interconnection of existing wells could be used to supplement well systems currently producing less than 0.75 inches per acre (if supplementation is needed). Water right 36-2080 authorizes diversion from 188 wells; A&B lists 175 currently active wells.
6. Well systems producing less than 0.75 inches per acre are generally located adjacent to or in the general vicinity of well systems producing more than this amount. It would be possible to move water from systems capable of higher diversion rates to “water short” systems or to specific land within “water short” well systems.

7. Water levels in the A&B area have declined as a result of (1) conversions from flood irrigation to sprinkler irrigation methods throughout the ESPA, (2) drought conditions, and (3) ground-water pumping.
8. It is not feasible to restore ground water levels to those observed in the 1950s through curtailment of junior-priority users because a return to 1950s water levels would require a return to flood irrigation and elimination of Palisades storage.
9. On average, A&B has deepened or replaced 1.8 wells per year since 1994. This is a modest number for a well-based water system of this size.
10. The reported rectification costs should be viewed in the context of system size. For example, the costs of $152,000 per year from 1995 to 2005 and the more recent annual cost of $206,000, when averaged over 66,686.2 acres, is equivalent to approximately $2.28 and $3.09 per acre, respectively. This compares with the current $70 per acre annual assessment cost for A&B members.
11. The A&B scenario does not in and of itself provide a basis for water administration. The scenario does not distinguish among various water rights, does not evaluate ground water level responses to a potential priority call, and does not consider various other factors influencing ground water levels in the A&B area.

Table of Contents

List of Exhibits

List of Appendices

1. INTRODUCTION

1.1. A&B Delivery Call

The A&B Irrigation District (A&B) filed a Petition for Delivery Call for the delivery of ground water on July 26, 1994. The petition sought administration of junior-priority ground-water rights and the designation of the Eastern Snake Plain Aquifer (ESPA) as a Ground Water Management Area (GWMA). An agreement signed by A&B, the Idaho Department of Water Resources (IDWR), and other participants on May 1, 1995 stayed the delivery call. A&B filed a Motion to Proceed on March 16, 2007, again seeking administration of junior-priority ground-water rights and the designation of the ESPA as a GWMA. The Director of IDWR denied A&B's Petition for Delivery Call and Motion to Proceed in an Order dated January 29, 2008. A&B filed a Petition Requesting Hearing on the Director's Order on February 13, 2008.

1.2. Purpose of Report

The purpose of this report is to review documents and data pertinent to the A&B water delivery call. Specific objectives of this effort were to:

1. Review claims made in A&B's Motion to Proceed (March 16, 2007), A&B's Petition Requesting Hearing on Director's January 29, 2008 Order, and selected affidavits;
2. Review diversion rates and volumes authorized under water rights held by A&B;
3. Review ground-water level trends;
4. Review circumstances surrounding selected well deepenings and replacements;
5. Consider the applicability of the A&B Scenario to the administration of water rights; and
6. Summarize results.

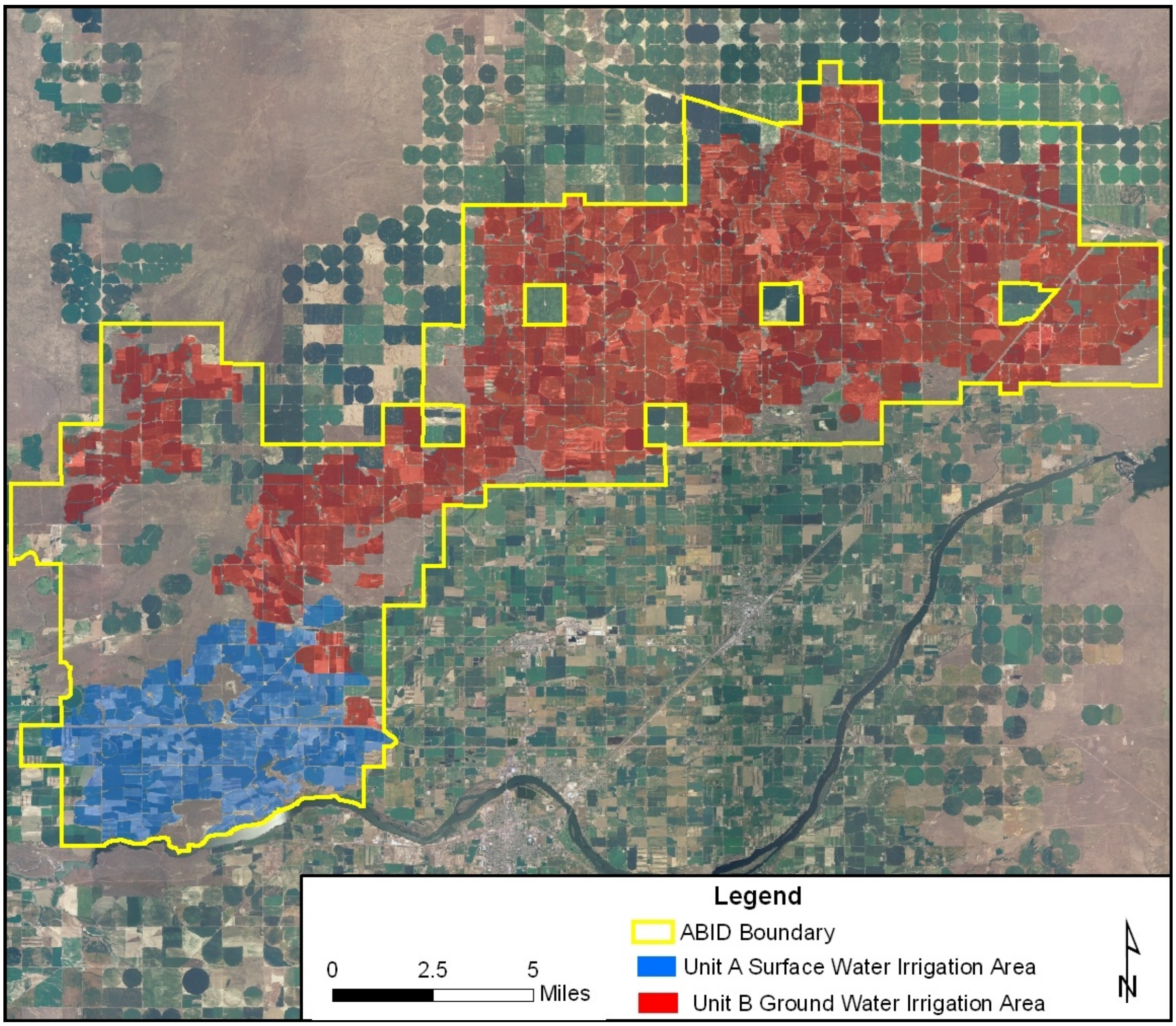
1.3. Report Organization

This report is organized into 7 sections, including this introduction. Section 2 provides a brief history of A&B well construction and a review of A&B water rights. Section 3 consists of a review of aggregate A&B ground-water withdrawals, an analysis of well system deliveries, and a discussion of sufficiency of supply. A review of ground-water levels, and discussion of reasons that water levels may begin to equilibrate, is provided in Section 4. Well deepenings and replacements are discussed in Section 5. There are a number of reasons that the A&B scenario is not suitable for water right administration in the A&B area – these are outlined in Section 6. Finally, Section 7 lists some of the conclusions drawn from this review.

2. BACKGROUND

2.1. History

A&B supplies irrigation water to 81,321.2 acres (Exhibit 401) in Minidoka and Jerome Counties in southern Idaho. Formerly the Northside Pumping Division, A&B is part of the Minidoka Project that was authorized by Congress on September 30, 1950 (CH2MHill, 2002). A&B entered into a contract (Appendix A, Exhibit 422) with the United States Bureau of Reclamation (USBR) in 1961 to repay the United States for the construction costs of the North Side Pumping Division of the Minidoka Project over a 50-year period. Repayment will be complete in 2020.



Data source: HDR GIS files (Item-q). Note: area indicated as Unit B ground water irrigation area is approximate; a shapefile showing actual irrigated Unit B land does not appear to exist.

Exhibit 401: A&B Irrigation District, Unit A and Unit B irrigation areas.

A&B is divided into two units – the "A unit" and the "B unit". The A unit is irrigated with surface water from the Snake River via a pumping plant located approximately 8 miles west of Burley, Idaho. Unit B is irrigated by ground water from about 177 wells originally constructed by the USBR and that are located throughout the Unit B area.

A&B assumed operation and maintenance responsibilities for operation of the District on March 1, 1966. A&B is administered by a Board of Directors consisting of 5 individuals residing within the project area. The Board hires a General Manager to administer policy and oversee operational activities. The current General Manager is Mr. Dan Temple.

2.2. Well Construction

A&B has a long history of well construction, deepenings, and replacements. Construction of irrigation wells began in 1948; most wells were constructed between 1953 and 1957. In total, A&B has drilled 184 wells (7 of which are replacement wells)[1]. Over the life of the project (1945 through present), A&B has drilled or deepened wells 313 times (Exhibit 402). More than half of A&B wells have been re-drilled or deepened at least one time[2] (Exhibit 403). Eighty four of 129 second, third, and fourth drills (approximately 65 percent) occurred prior to 1965 (Exhibit 404). On average, 1.1 wells were deepened or replaced each year between 1966 and 1993; an average of only 1.8 wells (or 1 percent of the total A&B wells) were deepened or replaced each year between 1994 and 2007.

Years	No. of 1st Drills	No. of 2nd Drills	No. of 3rd Drills	No. of 4th Drills	Total	Average per year(1)
1948-1965	176	81	3	0	260	4.9
1966-1993	2	16	10	1	29	1.1
1994-2007	6	7	9	2	24	1.8
1948-2007	184	104	22	3	313	

(1) includes 2nd, 3rd, or 4th drills for the 1948-1965 period, and all drills in the 1966-2007 period

Exhibit 402: Number of A&B 1st drills, 2nd drills, 3rd drills, and 4th drills, 1948-2007.

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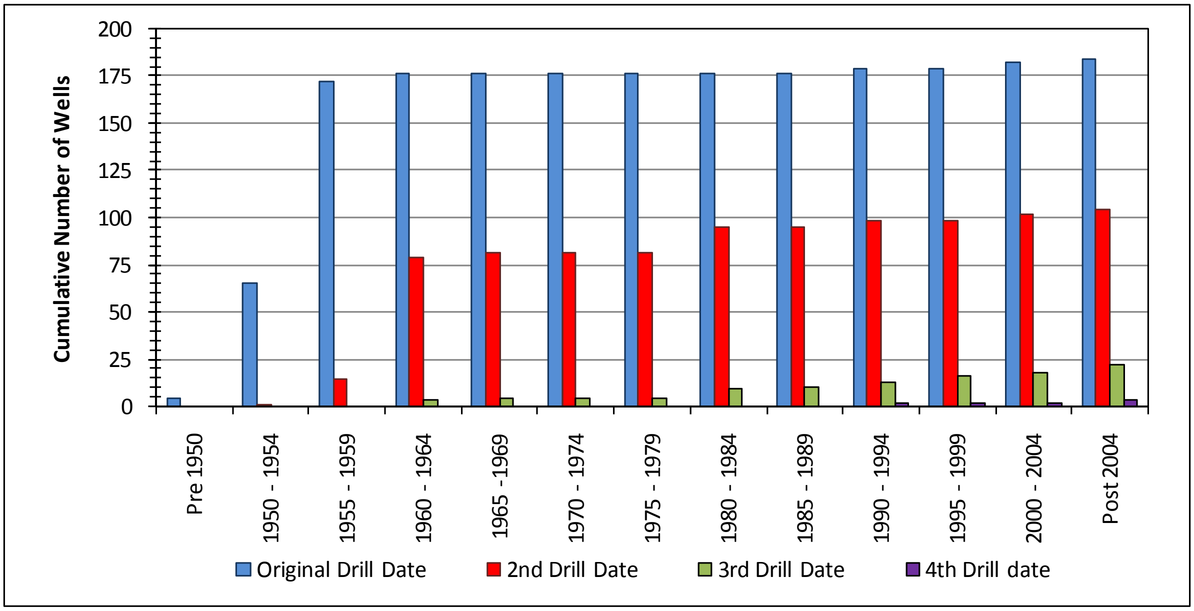
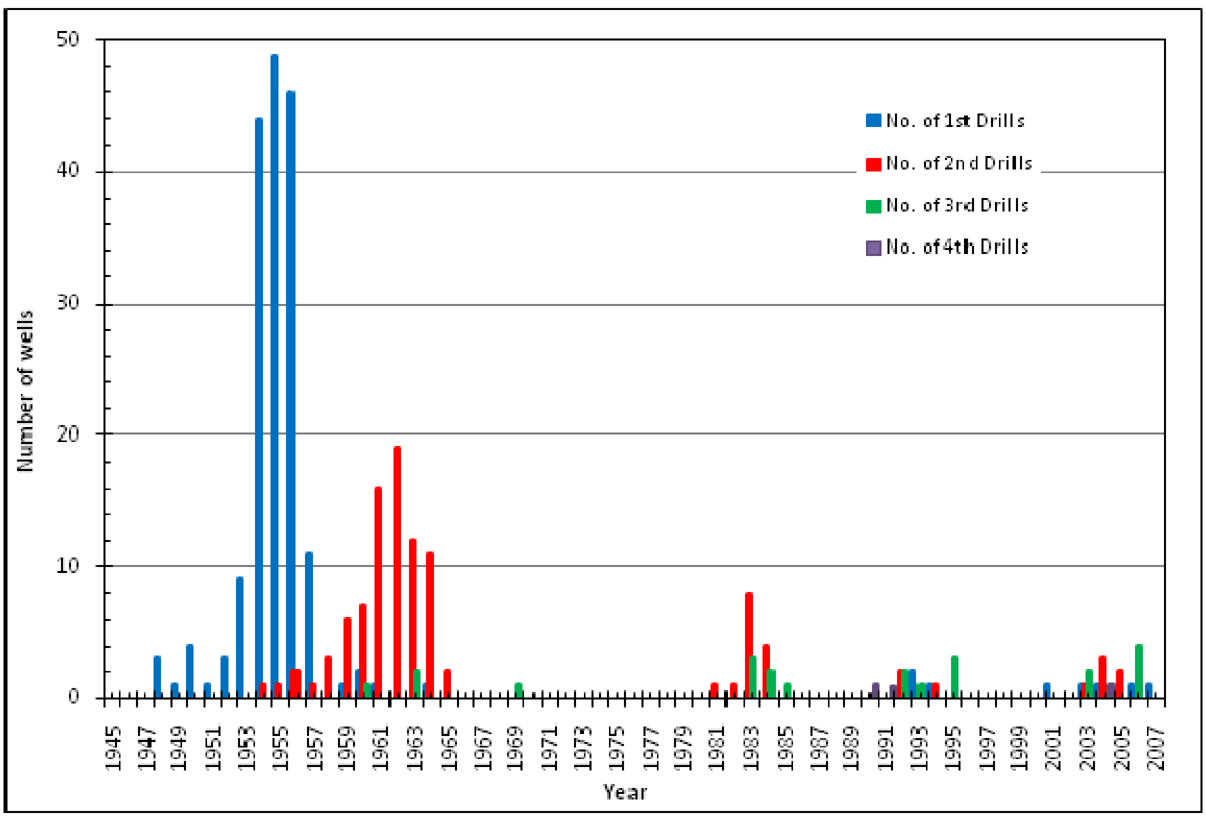
[1] *Based on data provided to IDWR, December, 2007 (Item F – Bowl sets and well data).*

[2] *A&B refers to the original drilling a first drill, the first deepening or replacement is a second drill, etc., the second deepening as a third drill, etc.*



Data source: "Item F – Bowl Sets and Well Data" Well Summary Table.xlsx

Exhibit 403: Cumulative drilling and construction of A&B irrigation wells).



Data source: "A&B Item F – Bowl Sets and Well Data" Well Summary Table.xlsx

Exhibit 404: Drilling and construction of A&B irrigation wells.

2.3. A&B Water Rights (Unit B)

The primary ground-water right (36-2080) used by A&B (but held by the USBR) authorizes a diversion rate of up to 1,100 cfs from 188 points of diversion (PODs). Water right 36-2080 authorizes an annual diversion volume of up to 250,417.2 acre-feet (AF) for the irrigation of 62,604.3 acres (Exhibit 405) within the A&B district boundaries. A 2006 transfer (No. 72566) also lists 188 points of diversion under water right 36-2080 (Appendix B, Exhibit 423). Several additional rights with priority dates ranging from 1962 through 1984 increased the authorized irrigated area to 66,686.2 acres (Exhibit 406) and the maximum volume to 266,744.8 afa (Exhibit 405). However, these rights, in combination with water right 36-2080, are limited to a maximum diversion rate of 1,100 cfs.

2.4. Discussion

A&B claims that ground-water level declines have resulted in a reduction of 126 cfs[3] from the diversion rate provided by its water right as decreed by the SRBA District Court. However, pumping by A&B in amounts less than the maximum authorized diversion rate or volume on water 36-2080 does not in and of itself represent injury.

The reduced diversion rate listed by A&B – 974 cfs – is an estimated rate based on the lowest recorded measurement in every well system. However, it is not clear that the lowest diversion from every well system (or every well within a well system) occurs at the same time. If it does not occur at the same time, then the estimated minimum aggregate rate of 974 cfs would be incorrect.

The primary ground-water right held by A&B (36-2080) authorizes a maximum diversion rate of 1,100 cfs. However, A&B has stated that 0.75 inches per acre delivered at the field turnout is a threshold under which delivery for irrigation is insufficient to meet crop needs. By inference, a delivery of more than 0.75 inches per acre, if not ideal, is sufficient based on A&B's internal standard of 0.75 inches per acre. A 0.75 inch per acre delivery rate to the originally licensed 62,604.3 acres with an assumed average 5 percent delivery loss would require a flow rate of approximately 990 cfs.

A standard of 5/8 (0.625) inches per acre has been established as an appropriate delivery rate for the American Falls Reservoir District #2 and North Side Canal Company[4] in the Surface Water Coalition delivery call for the Twin Falls Canal

[3] *A&B Motion to Proceed, March 16, 2007, pg 2*

[4] *Amended Order in the Matter of Distribution of Water to Various Water Rights held by or for the Benefit of A&B irrigation District, American Falls Reservoir District #2, Burley Irrigation District, Milner Irrigation District, Minidoka Irrigation District, North Side Canal Company, and Twin Falls Canal Company, May 2, 2005, Finding of Fact 89, pg 19-20.*

Company[5]. Thus, A&B can meet crop needs with a delivery rate that is less than 1,100 cfs.

A&B expanded the original irrigable acreage licensed under water right 36-2080 by 4,086.9 acres through beneficial use claims and/or enlargements (with priority dates ranging from April 1, 1962 through April 1, 1984). Using the A&B minimum delivery criterion of 0.75 inches per acre, A&B likely uses at least 61.3 cfs of the 1,100 cfs authorized under water right 36-2080 to irrigate expansion acres authorized under junior rights. Again, less water than the maximum diversion rate of 1,100 cfs is required for the irrigation of the original 62,604.3 irrigable acres.

Water Right No.	Basis*	Priority Date	Diversion Rate (cfs)	Diversion Volume (afa)	Irrigation (acres)	Notes/Conditions
36-2080	Original license	9/9/1948	1,100.0	250,417.2	62,604.30	Limited to 1100 cfs, 266,744.8 afa, 66,686.2 acres when used with other water rights listed here
36-15127A	Beneficial Use	4/1/1962		7,545.6	1886.4	
36-15192	Beneficial Use	4/1/1962		145.2	36.3	
36-15193A	Beneficial Use	4/1/1962		50.0	12.5	
36-15194A	Beneficial Use	4/1/1962		54.8	13.7	
36-15195A	Beneficial Use	4/1/1962		210.0	52.5	
36-15196A	Beneficial Use	4/1/1962		69.6	17.4	
36-15193B	Enlargement	4/1/1965		75.6	18.9	
36-15194B	Enlargement	4/1/1968		609.6	152.4	
36-15195B	Enlargement	4/1/1978		542.4	135.6	
36-15196B	Enlargement	4/1/1981		18.8	4.7	
36-15127B	Enlargement	4/1/1984		7,006.0	1751.5	
		Totals	1,100.0	266,744.8	66,686.2	
* Partial decrees have now been issued in the SRBA for all of these rights						

Source file: A&B Water Rights.xlsx

Exhibit 405. Ground-water rights held by A&B.

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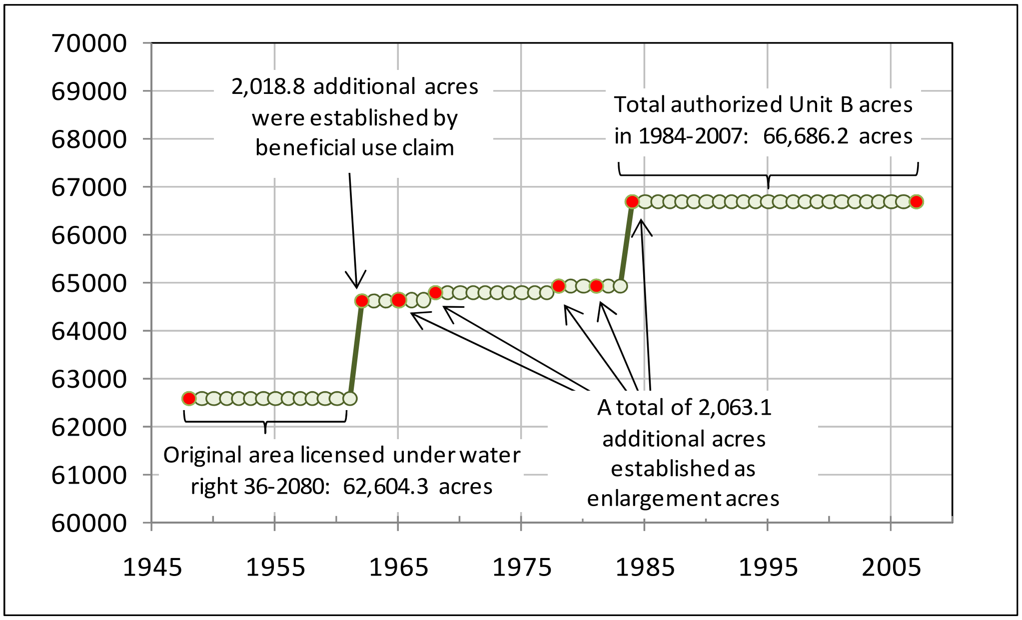
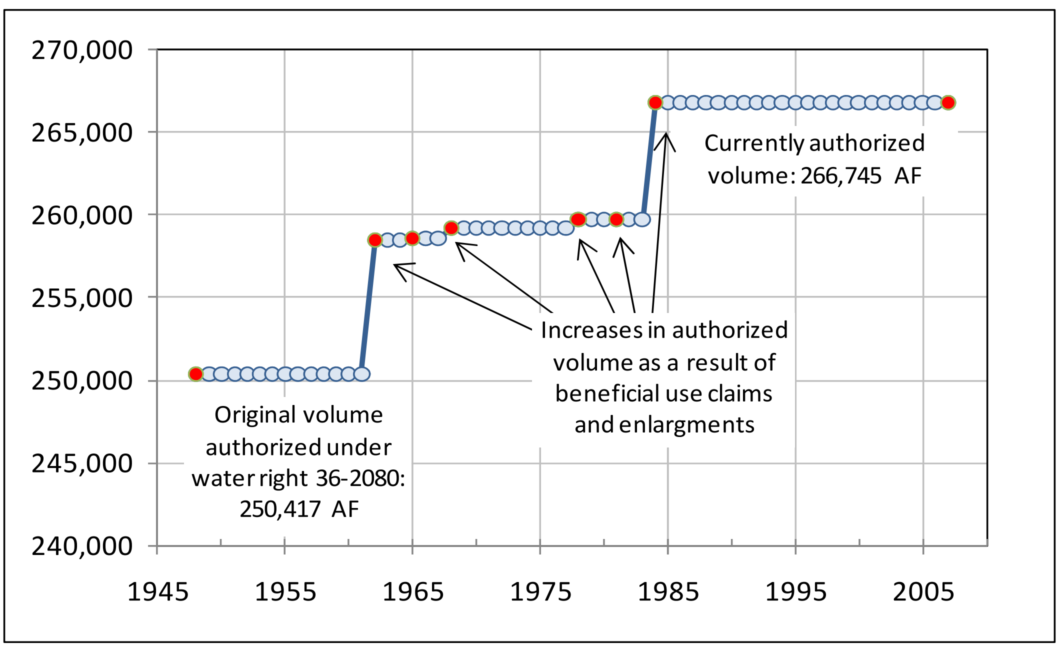
[5] *In the Matter of Distribution of Water to Various Water Rights Held by or for the Benefit of A&B Irrigation Dist., American Falls Reservoir Dist. #2, Burley Irrigation Dist., Milner Irrigation Dist., Milner Irrigation Dist., Minidoka Irrigation Dist., North Side Canal Co., and Twin Falls Canal Co., Opinion Constituting Findings of Fact, Conclusions of Law and Recommendation, April 29, 2008, pg*



Source: IDWR online water rights database. Note truncated y axis. *Source file: A&B Water Rights.xlsx*

Exhibit 406: Acreage under water rights 36-2080, 36-15127A, 36-15192, 36-15193A, 36-15194A, 36-15195A, 36-15196A, 36-15193B, 36-15194B, 36-15195B, 36-15196B, and 36-15127B.



Source: IDWR online water rights database. Note truncated y axis. *Source file: A&B Water Rights.xlsx*

Exhibit 407: Authorized diversion volumes under water rights 36-2080, 36-15127A, 36-15192, 36-15193A, 36-15194A, 36-15195A, 36-15196A, 36-15193B, 36-15194B, 36-15195B, 36-15196B, and 36-15127B.

Water right 36-2080 provides for annual maximum diversion volume of 250,417.2 acre-feet (AF) for the irrigation of 62,604.3 acres. Prior to 1994, annual withdrawals averaged 193,500 acre feet, with a maximum diversion of 226,255 acre feet in 1966. Injury has not been claimed prior to 1994. Diversions of less than 250,417.2 acre feet per year have been sufficient for the intended beneficial use.

2.5. Summary

A&B claims that ground-water level declines have resulted in a reduction of 126 cfs from the diversion rate provided under water right 36-2080. However, diversions of less than 1,100 cfs and 250,417.2 acre feet per year have been sufficient for the intended beneficial use and do not represent injury.

3. Diversions Under Water Right 36-2080

A&B claims material injury from reduced ground-water diversions caused by lowered ground-water levels in the Eastern Snake Plain[6]. Diversions have decreased, but the decrease is consistent with increases in both irrigation efficiency and conveyance efficiency within the A&B system. This section examines trends in ground-water diversions under water right 36-2080 based on data submitted by A&B. Aggregate (i.e., system-wide) ground-water withdrawals are examined in Section 3.1; water deliveries for individual well systems are examined in Section 3.2 (beginning on page 9).

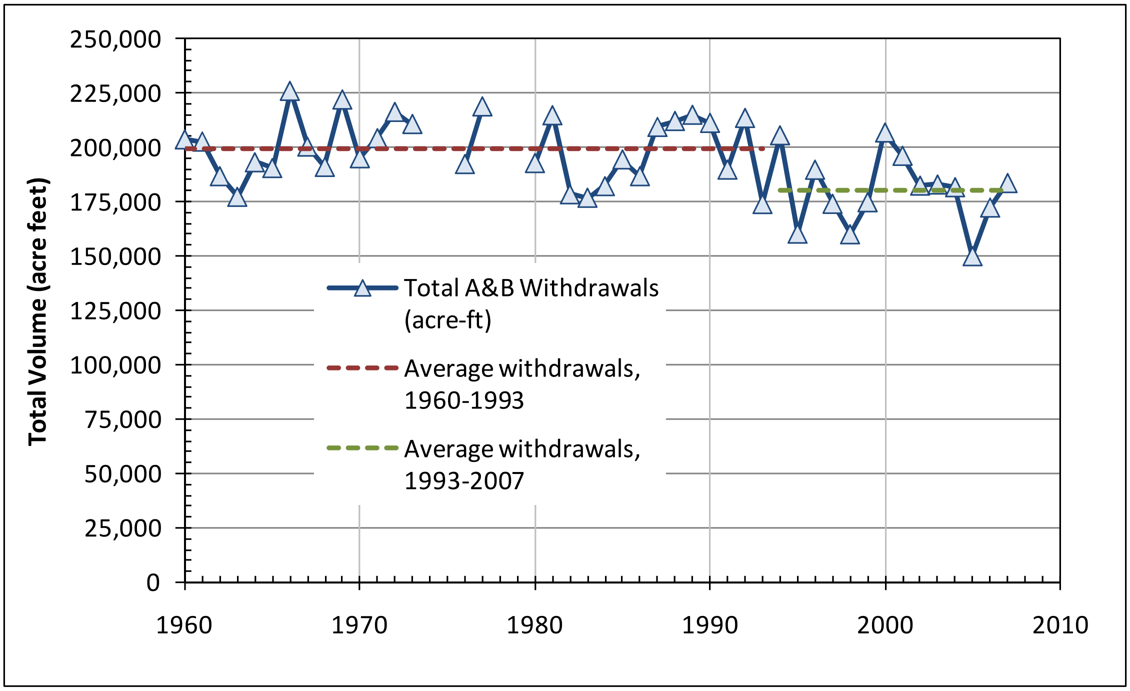
3.1. Aggregate Ground-Water Withdrawals

Annual ground-water withdrawals since 1960 under water rights held by A&B (Section 2.3) have averaged approximately 193,500 acre feet per year (afa). Prior to 1993, annual withdrawals averaged approximately 199,700 afa (Exhibit 408). Between 1994 and 2007 (inclusive), annual ground-water withdrawals averaged about 180,300 afa (Exhibit 409), representing a decrease of approximately 9.7 percent from the 1960-1963 period.

Category	Average 1960-2007	Average 1963-1993	Average 1994-2007
Total Annual Withdrawals (af)	193,481	199,654	180,253
Diversions per the 62,604 acres licensed under water right 36-2080 (af/acre)	3.09	3.19	2.88
Diversions per the 66,686 acres included under all A&B water rights (af/acre)	2.90	2.99	2.70

Exhibit 408: Average annual ground-water withdrawals.

[6] *A&B Motion to Proceed, March 16, 2007*



Data source: A&B data (Item A production data) WaterPumpedRevised.xlsx

Exhibit 409: Total A&B Withdrawals.

Annual ground-water withdrawals ranged from a low of 150,163 acre feet in 2005 to a high of 226,255 acre feet in 1966. Interestingly, ground-water withdrawals rose in 2006 and 2007 (to 172,525 acre feet and 183,834 acre feet, respectively) from the 2005 low (150,163 acre feet), despite ground-water level declines (see Section 3.3).

The annual average diversion per acre (based on original 62,604 acres licensed under water right 36-2080) was approximately 3.19 acre feet per acre from 1960 through 1993 and 2.88 af/acre in 1994 through 2007. The lowest reported diversion per acre was 2.40 acre feet per acre in 2005 (Exhibit 410), but the diversion increased to 2.76 and 2.94 acre feet per acre in 2006 and 2007, respectively, despite ground-water level declines.

3.2. Reduced Deliveries Per Well System

A&B delivers water via approximately 133 well systems[7] distributed throughout the Unit B service area. A well system consists of 1 or more wells delivering water to 1 or more farm units. In aggregate, the well systems originally delivered water via 177 wells. A&B claims that it has been injured because deliveries from 40 well systems[8] have fallen below 0.75 inches per acre. A&B's Motion to Proceed states that "A&B is

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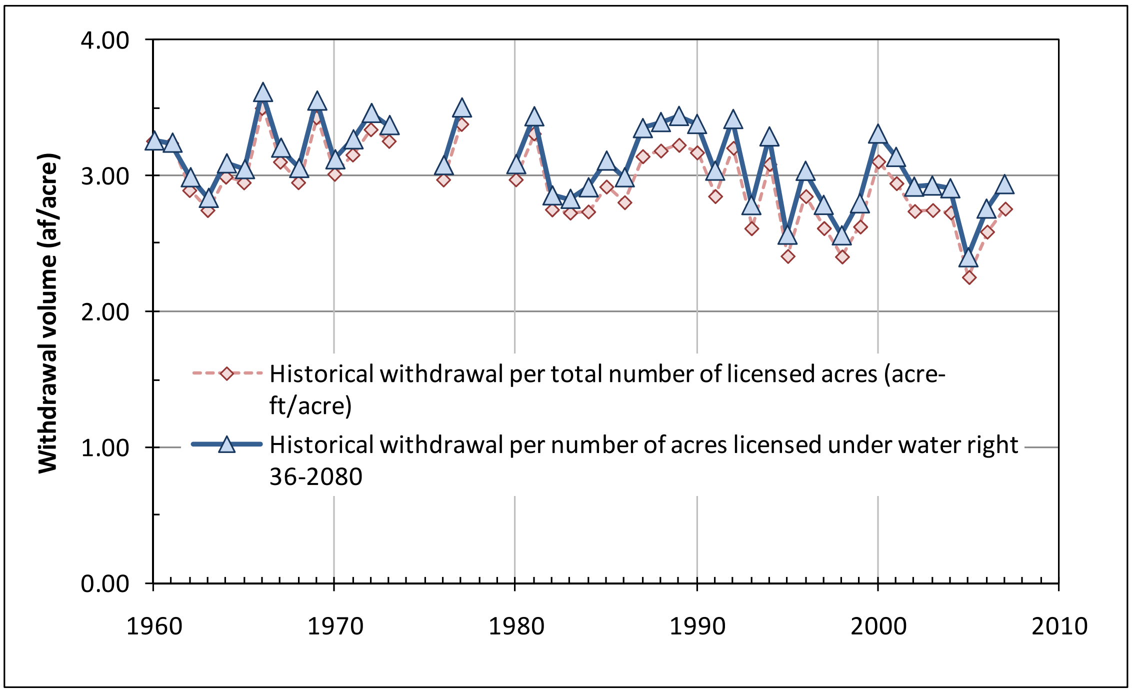
[7] *Based on data in A&B Annual Report, 2007*

[8] *A&B Motion to Proceed, March 16, 2007, pg 2.*

unable to divert an average of 0.75 of a miner's inch per acre which is the minimum amount necessary to irrigate lands within A&B during the peek [sic] periods when irrigation water is most needed" (paragraph 11.d.). This section examines implications of the reported water deliveries of less than 0.75 inches per acre in the A&B well systems.



Data source: A&B data (Item A production data) WaterPumpedRevised.xlsx

Exhibit 410: A&B annual withdrawals per current water-right acres and per the original 62,604 acres listed on water right 36-2080.

The following sections explore the basis for the 0.75 inch per acre delivery standard and the implications of using it as a basis for identifying "water short" lands. However, this discussion is not intended to infer validity to the internal A&B standard. A 5/8 (0.625) inch per acre is an acceptable and appropriate delivery amount.

Deliveries of 0.75, 0.824, and 0.88 inches per acre are substantially greater than the delivery rate of 5/8 (0.625) inch per acre established for other ESPA entities. An Amended Order (May 2, 2005) noted that the American Falls Reservoir District #2 and the North Side Canal Company define full headgate deliveries as 5/8 (0.625) inch per acre[9]. The Amended Order also noted that the full supply of water cannot be

[9] *Amended Order in the Matter of Distribution of Water to Various Water Rights held by or for the Benefit of A&B irrigation District, American Falls Reservoir District #2, Burley Irrigation District, Milner*

determined for A&B from the headgate delivery information provided by the other Surface Water Coalition Members[10] (likely because specific information for A&B had not been provided). Furthermore, the Hearing Officer in the Surface Water Coalition (SWC) delivery call found that "full headgate delivery for Twin Falls Canal Company should be calculated at 5/8 inch instead of ¾ inch" per acre[11].

3.2.1. Basis of 0.75 inch-per-acre Criteria

The 0.75 inch per acre delivery standard is an inferred standard that is used in A&B annual reports. There is no reference to a 0.75 inch per acre delivery threshold in the Water Right Report for water right 36-2080. The A&B annual reports list a criterion of the "inches req. to deliver 0.75" per acre at turnout" (i.e., inches required to deliver 0.75 miners' inches per acre at turnout). Prior to 1972, the criterion was listed as "Req. at well(s) to del. .73 per ac at T.O. c.f.s" (i.e., the requirement at well(s) to deliver 0.73 miners' inches per acre at a field turnout, in cfs). Mr. Temple confirmed[12] that the A&B Board changed the criteria in the early 1970s.

Mr. Temple also testified in deposition[13] that the 0.75 inches per acre delivery standard is also used as a rectification threshold. In other words, wells or well systems are determined by A&B to require remedial action if the delivery is less than 0.75 inches per acre. Rectification could include well deepening, well replacement, repairing pump damage caused by sand pumping, or other measures to increase ground-water diversions.

The use of a per-acre or per well system delivery standard is an awkward measure of adequate water supply under a water right. First, the standard suggests that a pumping rate for a well delivering water to a given amount of land is somehow ensured *ad infinitum* into the future. In fact, initial pumping rates in a well may not be sustainable because of limiting aquifer characteristics, borehole changes (e.g., sand sloughing into a well), changes in recharge patterns (e.g., reduced recharge because of conversions of gravity irrigation to surface water), local water-level declines (such as a local cone of depression formed from a well or multiple wells).

Irrigation District, Minidoka Irrigation District, North Side Canal Company, and Twin Falls Canal Company, May 2, 2005, Finding of Fact 89, pg 19-20.

[10] *Ibid, Finding of Fact 94, pg 20.*

[11] *In the Matter of Distribution of Water to Various Water Rights Held by or for the Benefit of A&B Irrigation Dist., American Falls Reservoir Dist. #2, Burley Irrigation Dist., Milner Irrigation Dist., Milner Irrigation Dist., Minidoka Irrigation Dist., North Side Canal Co., and Twin Falls Canal Co., Opinion Constituting Findings of Fact, Conclusions of Law and Recommendation, April 29, 2008 , page 53.*

[12] *Dan Temple deposition, June 24, 2008, pg 84, lines 1-2*

[13] *Dan Temple deposition, June 24, 2008, pg 52, lines 23-25*

Second, if the per-acre delivery standard were to be used as a basis for water right administration, it would be critical to be able to verify the number of actual irrigated acres being used for calculating the delivery rates. The acreage that is actually irrigated in a well system area and the total amount of water that is being applied to land within the well system area is not available.

The Bureau of Reclamation (USBR) defined the precise number of irrigable acres within a well system in the 1950s[14]. The irrigable area was defined, in part, based on topographic constraints imposed by gravity irrigation methods. In the intervening years, the actual irrigated acreage within a well system has changed with the utilization of sprinkler irrigation systems, farm unit changes, property changes, and other reasons. For example, comparison of 1987 and 2004 aerial imagery indicates changes in irrigated acreage, and now a number of "water short" well systems have new center pivots or sprinkler-irrigated fields that straddle well system boundaries. It is difficult to determine from aerial imagery the source of water (i.e., the specific well) serving a particular pivot or field that straddles a well system boundary. Mr. Temple has described a conscientious in-district tracking system to ensure that the original number of irrigable acres has not changed over time[15]. This may be, but it is difficult (if not impossible) to verify actual irrigated acreage using spatial methods with the information that A&B has provided. It is therefore difficult to spatially identify those lands actually irrigated by wells within "water short" well systems.

The Department recognized in its January 29, 2008 Order that "representatives of A&B state that the 'acreage per system' values included in A&B records are lands in the project originally classified as irrigated lands, and are not necessarily representative of the actual acres currently irrigated by the well systems" (paragraph 68). Thus, there appears to be no current mapping that would identify those lands that are actually irrigated with A&B ground water.

Third, determining delivery requirements is confounded by the presence of private water right places of use (for irrigation rights) within the A&B service area (Exhibit 411) and within individual well system lands (Exhibit 412). Some of the private water rights appear to be used to supplement A&B water, and/or is co-mingled with A&B water, although the extent to which this occurs is unclear.

A&B has established a co-mingling policy to prevent the use of A&B water on non-A&B lands at a special March 13, 2003 Board of Directors meeting[16] (Appendix C, Exhibit 424). The policy specifies that private water may or may not be used on A&B lands, "depending on the place of use element of the right." However, the policy does not appear to exclude pumping water under private rights to supplement A&B water if the place of use listed in the private right coincides with District lands. Minutes from a

[14] *The original irrigable areas were recorded in "hard sheets."*

[15] *Dan Temple deposition, June 24 and 25, 2008.*

[16] *Materials provided by A&B under the name of "Comingle Info.pdf."*

special meeting of the A&B Board of Directors on March 28, 2002 note that there are "several different scenarios on how commingling is taking place on farm units". The bottom line is that a delivery by A&B of less than 0.75 inches per acre in a particular well system may be sufficient if water under private rights is being used to supplement A&B water.

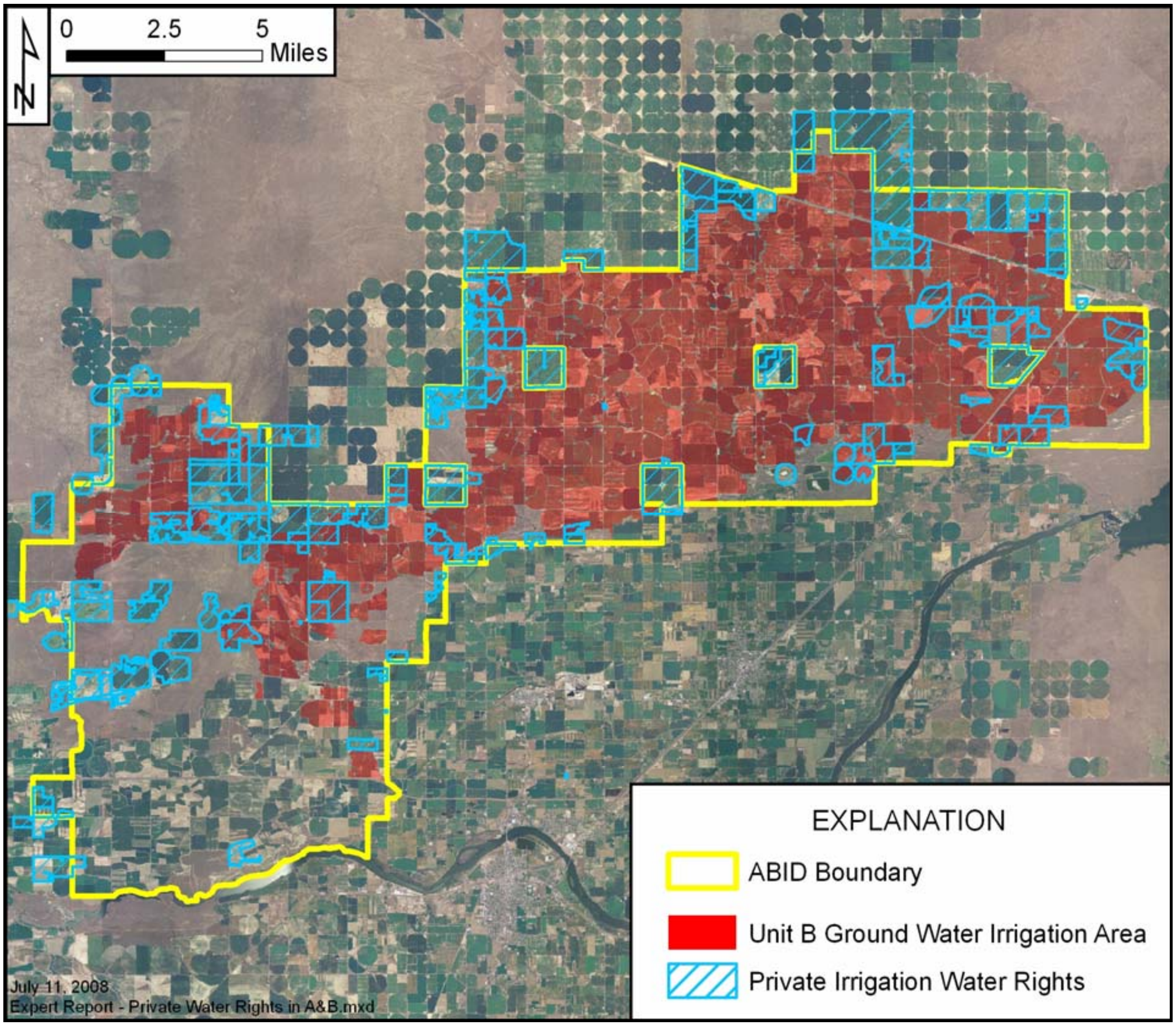


Exhibit 411: Unit B lands and place of use for private irrigation water rights.

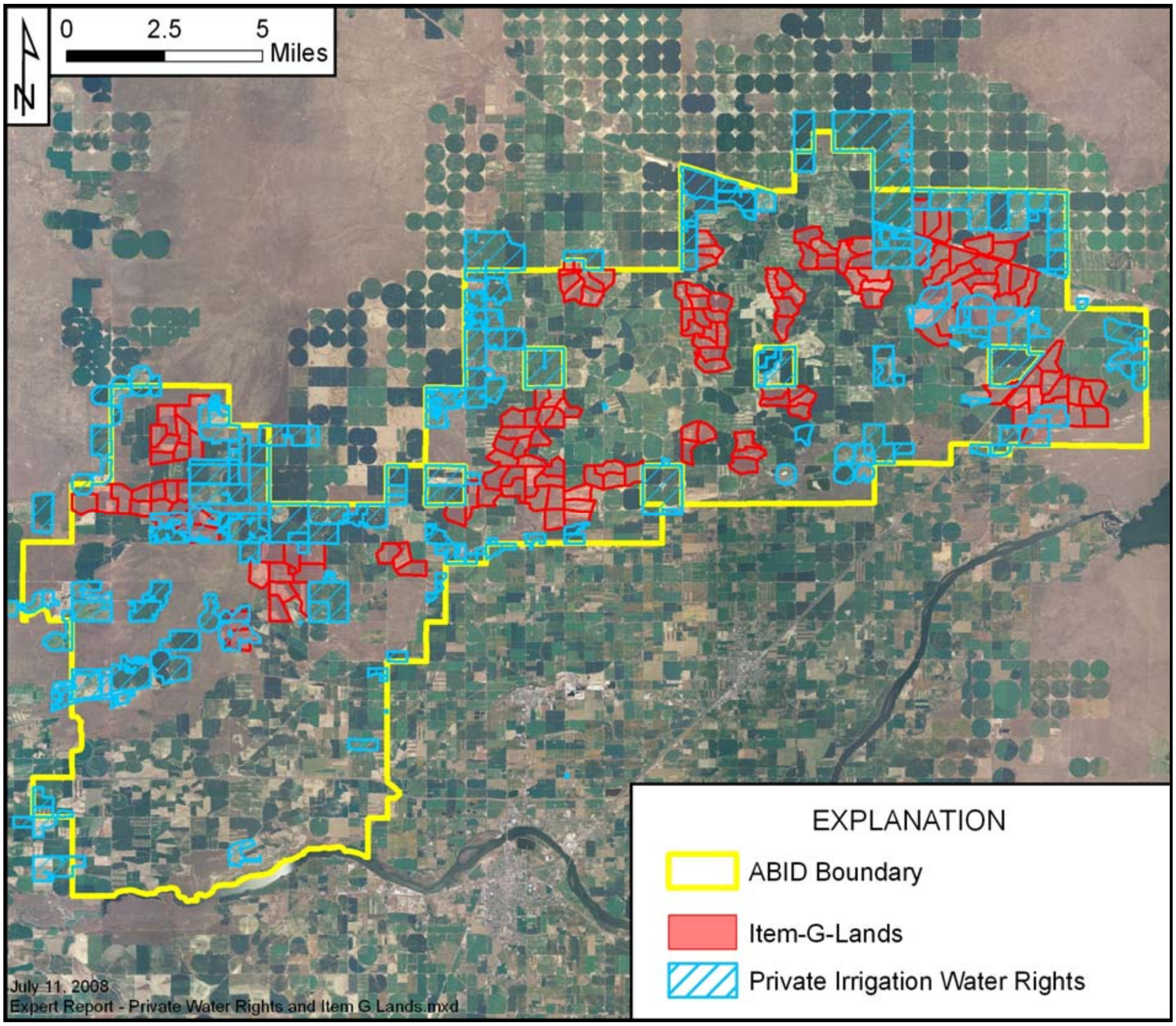


Exhibit 412: "Water short" well systems (Item-g-lands) and place of use for private irrigation water rights within the A&B service area.

Fourth, the delivery-per-acre values depend, in part, on the point at which flows are measured. A&B reports deliveries per acre at the field turnout. An alternative measuring point, which would more accurately reflect actual well production, would be at the wellhead. The difference between measurements taken at the field turnout and at the wellhead is conveyance loss. Some of the conveyance loss in the annual report may also include "waste" – water that was delivered in excess of a particular farmer's order. Both the conveyance loss and "waste" – to the extent which it occurs – varies over time and influences measurements of water delivery from a well system.

Finally, the annual delivery per acre appears to be calculated (in most cases) using the lowest discharge reading of the year. A&B's data do not provide the length of time at which the system was operating at the lower rate. Operation for a short amount of time at an exceptionally low rate over a 24-hour period would distort conclusions regarding actual low pumping rates.

3.2.2. History and Distribution of “Water Short” Well Systems

The percentage of acreage served by “water short” well systems was examined using the annual report data (acreage served by well system, delivery per acre) provided by A&B. “Water short” well systems delivered water to approximately 29 percent of the A&B area in 1963 and 20 percent of the total A&B area in 2007 (Exhibit 413). Not surprisingly, the percentage of “water short” well systems is substantially less if the diversion per acre as measured at the wellhead is used (Exhibit 414).

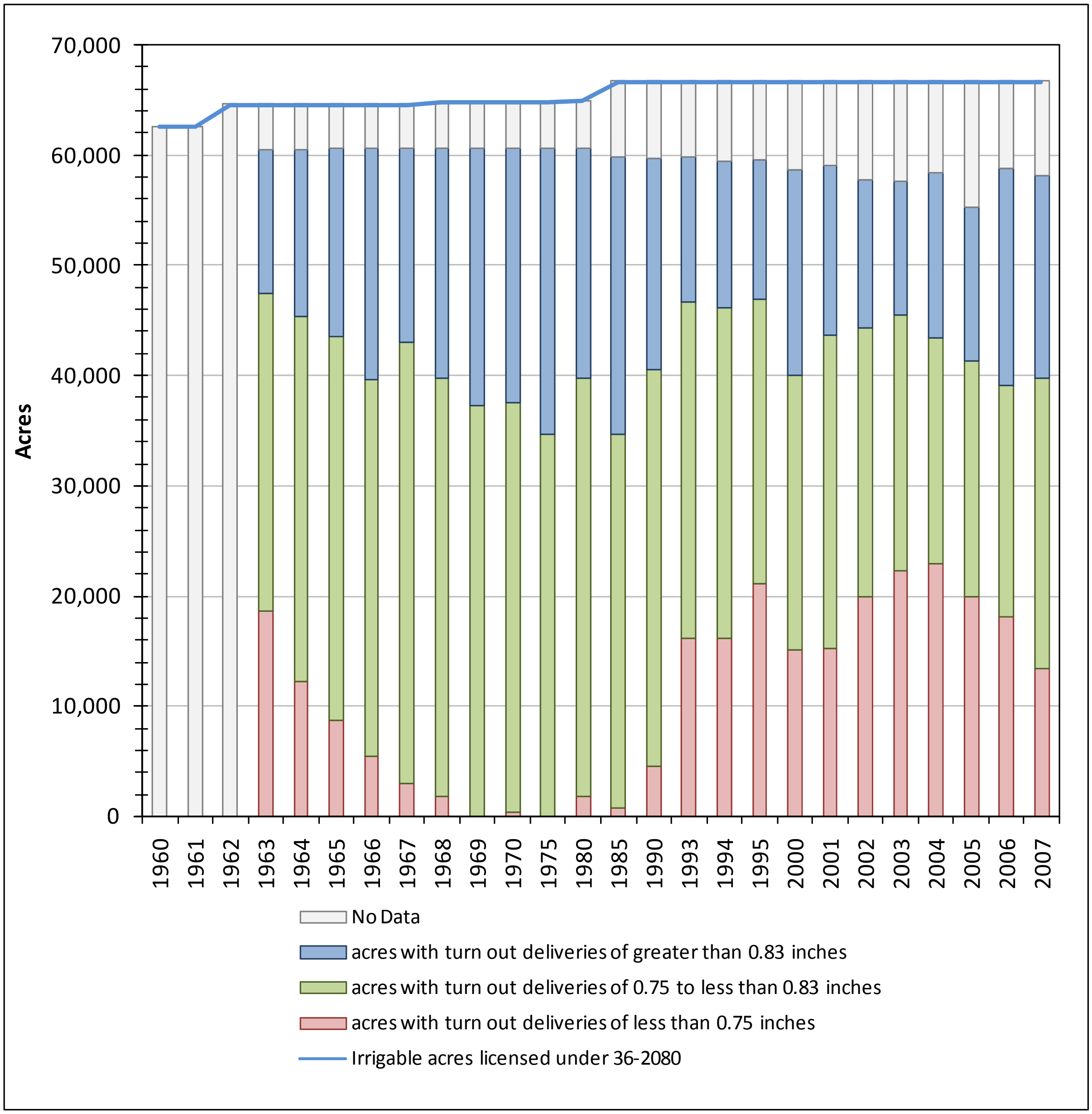
The number of well systems defined by A&B as “water short” has decreased in recent years. For example, 44 well systems were listed as “water short in 2004, 36 wells systems were listed as “water short” in 2005 and 2006, and 25 well systems were listed as ‘water short” in 2007. The number of well systems producing more than 0.75 inches per acres has *increased* despite water-level decreases during these years (water-level trends are discussed in Section 3.5 below).

Similarly, deliveries to 29 percent of A&B irrigated lands in 1963 were less than 0.75 inches per acre. In 2004, deliveries to 34 percent of irrigated land was less than 0.75 inches per acre. This percentage decreased to 30 percent in 2005, 27 percent in 2006, and 20 percent in 2007. Notably, the more acreage received at least 0.75 inches per acre in 2006 and 2007 than in 1963.

Many of the well systems reported as delivering less than 0.75 inches per acre are actually delivering close to this threshold. For example, 21 of the 25 well systems listed as “water short” actually delivered between 0.70 and 0.75 inches per acre at the turnout.

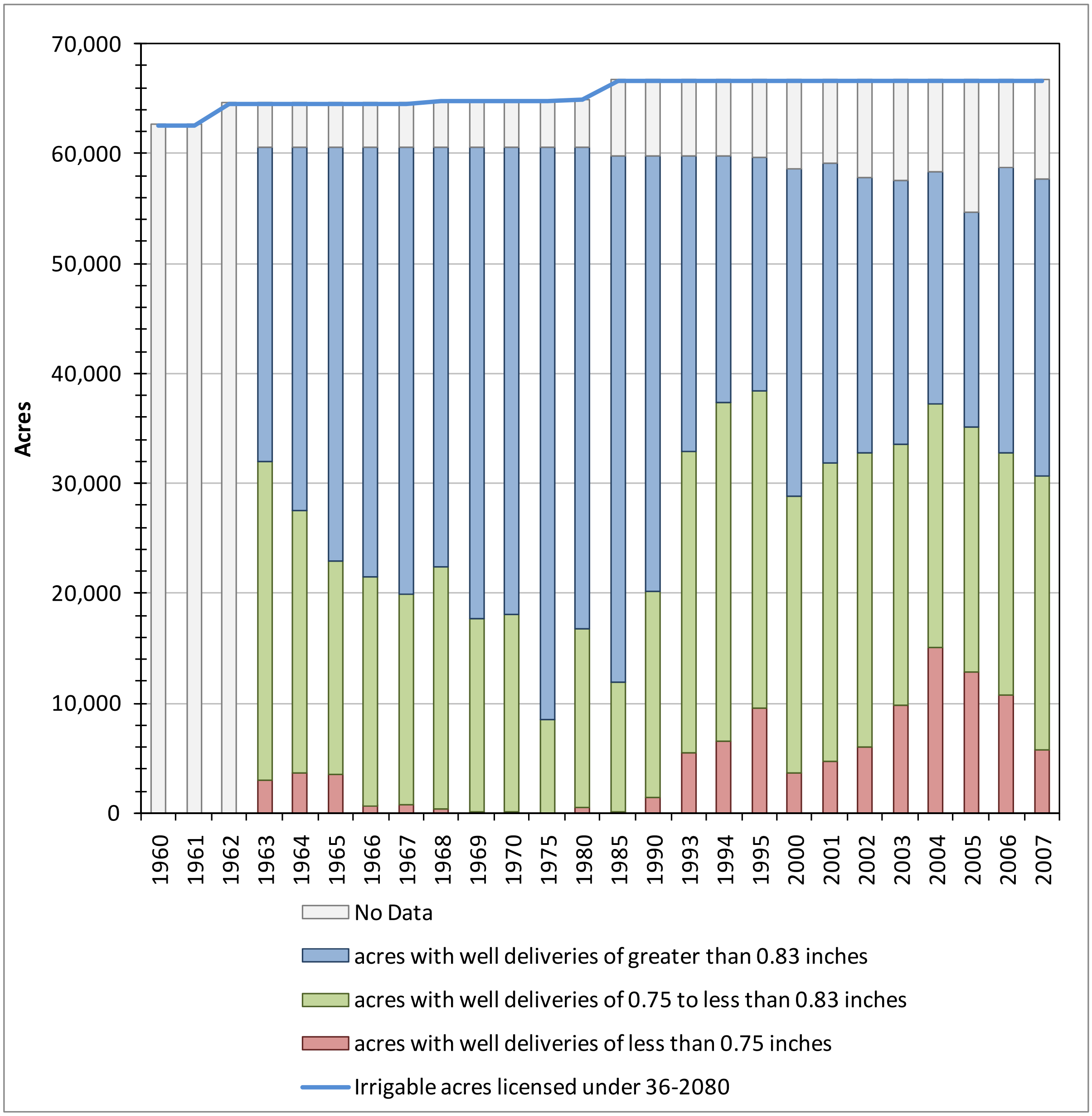
Many well systems are capable of diverting more than the internal 0.75 inch per acre minimum delivery standard. For example, 52 well systems delivered more than 0.824 inches per acre (i.e., the calculated average duty of water for the A&B water rights) in 2007. Six well systems (27AC823, 10C824, 28C823, 3BC921, 31A724, and 15B824) delivered more than 1 inch of water per acre in 2007.

Thus, while approximately 13,371 acres were served with less than 0.75 inches per acre in 2007, more than 18,452 acres were served with more than 0.824 inches per acre. Many of the “water short” well systems are scattered throughout the A&B area. It would be possible to shift demand (by shifting irrigated acres) from systems producing less than 0.75 inches per acre to adjoining systems producing greater amounts.



Source: A&B Annual Reports *File: Annual_Reports_Delivery_Analysis.xls (delivery by acre charts)*
Note truncated x-scale

Exhibit 413: "Water short" well systems for selected years.



Source: A&B Annual Reports *File: Annual_Reports_Delivery_Analysis.xls (delivery by acre charts)*
Note truncated x-scale

Exhibit 414: "Water short" well systems (as measured near the wellhead) for selected years.

The land area served by reported "water short" well systems[17] is distributed throughout the A&B service area (Exhibit 415). Corresponding boundaries of well systems delivering greater than 0.75 inches per acre were not provided by A&B (and appear to be unavailable). However, many (if not most) of the "water short" well systems are located in the general vicinity of wells listed as producing more than 0.75 inches per acre. The same pattern holds if the "water short" criteria of 0.75 inches per acre at the wellhead is used (Exhibit 416).

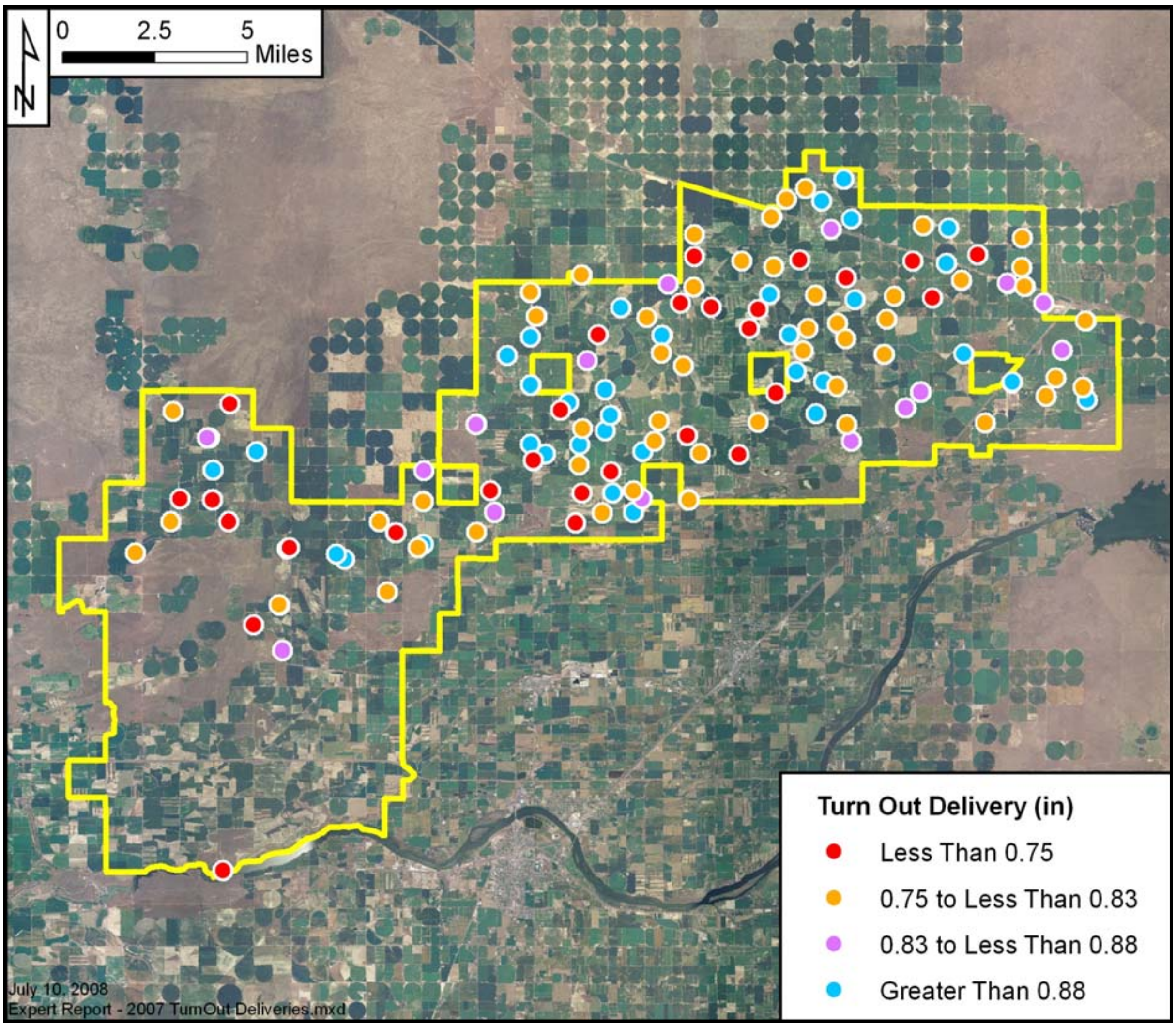


Exhibit 415: Distribution of "water short" well systems based on delivery at the turnout, 2007.

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[17] Data provided by A&B as "Item-g lands."

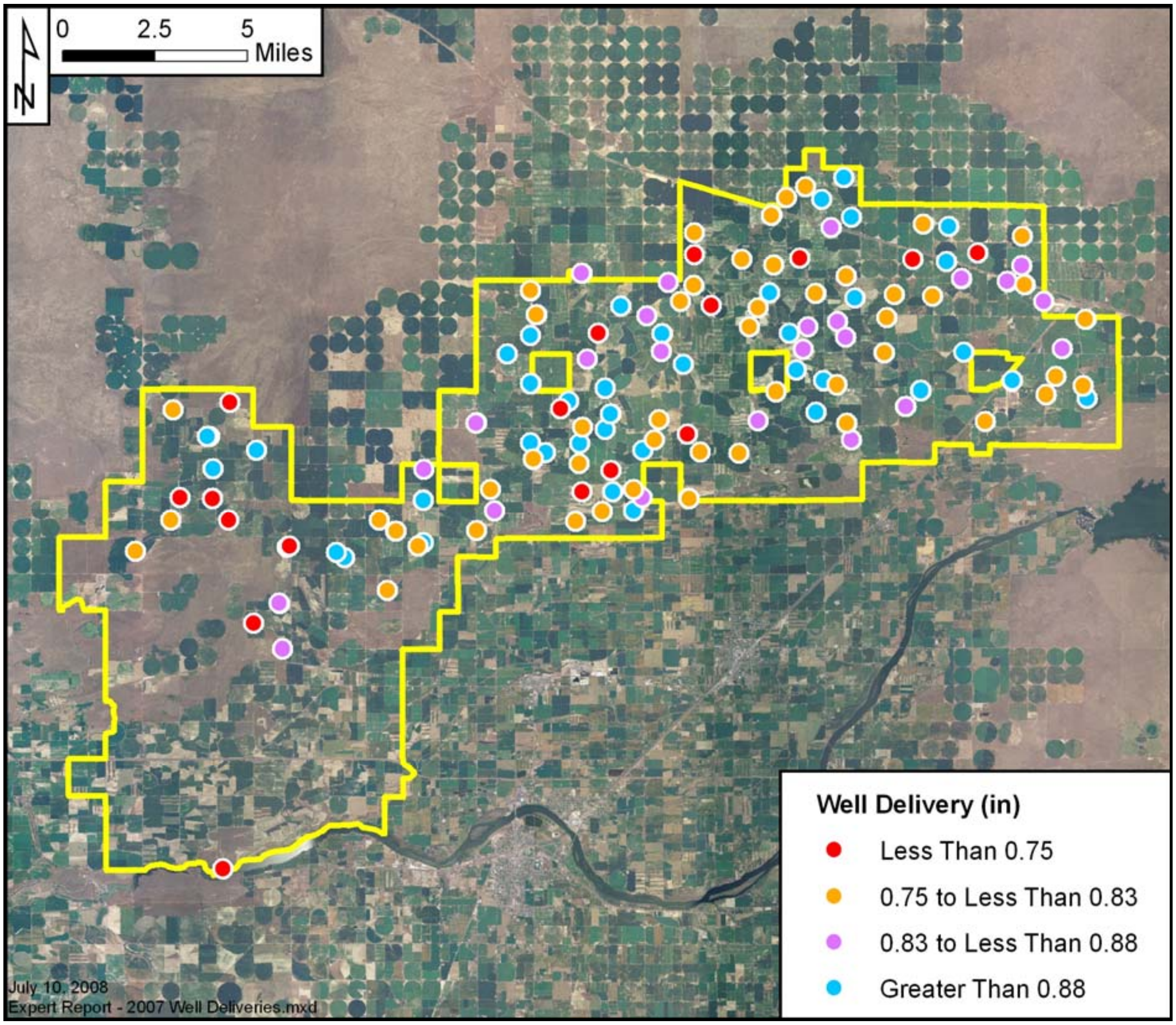

Exhibit 416: Distribution of “water short” well systems based on delivery at the wellhead, 2007.

3.3. Implications of Reduced Annual Diversions

Insufficient ground-water withdrawals could lead to (1) reductions in irrigated area (i.e., drying up of irrigated land), (2) a shift to lower-demand crops, (3) or reduced crop yields. However, no evidence quantifying any of these has been provided.

3.3.1. Irrigated Area

Reduced annual ground-water withdrawals could conceivably force a decrease in irrigated area. However, acreage irrigated with water from wells authorized under water right 36-2080 has increased by 4,081.9 acres under beneficial use claims and enlargements. This represents an increase in irrigated area of approximately 6.5

percent over the original 62,604.3 licensed acres. Reduced annual ground-water withdrawals clearly have not led to reduced irrigated acreage.

3.3.2. Shift to Lower-Demand Crops

Reduced annual withdrawals could have resulted in crops with a lower water demand. However, this has not happened.

A&B reports that "there isn't a significant difference in average crop distribution between Unit A or B"[18]. The A-Unit is irrigated with surface water and "appears to have a sufficient water supply, through its storage, to delivery (sic) a full water supply to its landowners for irrigation"[19]. A similar crop mix in both units suggests that growers in the B-Unit have not shifted to crops with a lower water demand, and, by implication, have sufficient water to grow the same crops that are grown in the A-Unit.

3.3.3. Decreasing Crop Yields

Decreased aggregate ground-water withdrawals could result in decreased crop yields. However, no data or information showing lands that have been left fallow or crops that have gone unharvested as a result of insufficient water has been provided.

3.4. Factors Contributing to Sufficiency of Supply

Several factors contribute to sufficiency of supply, including reduced injection, increased irrigation efficiency, and reduced conveyance losses.

3.4.1. Reduced injection

The Bureau of Reclamation (USBR) originally designed and constructed 79 drain wells as part of the North Side Pumping Division (NSPD) of the Minidoka Project; 52 of the wells were still active in 1993 (Bureau of Reclamation, 1993). The purpose of the drain wells was to dispose of irrigation returns and storm runoff.

The drain wells came under regulation of the Underground Injection Control (UIC) Program, mandated by the Federal Safe Drinking Water Act, after the project was completed and operational responsibility was transferred to the A&B Irrigation District. Concerns about biological contaminants (e.g., coliform bacteria), turbidity, and other potential contaminants led to the abandonment of the wells. All but approximately 10

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[18] Information from A&B in Response to Order Requesting Information for A&B Delivery Call, December 14, 2007, Item e, pg 2.

[19] Affidavit of Dan Temple in the Matter of Distribution of Water to Various Water Rights held by or for the benefit of A&B Irrigation District, American Falls Reservoir District #2, Burley Irrigation District, Milner Irrigation Dsitrict, Minidoka Irrigation District, North Side Canal Company, and Twin Falls Canal Company, June 21, 2007.

of the wells are now abandoned; the remaining injection wells are no longer used for the injection of irrigation return flows[20].

Any reduction in return-flow injection should correspond with decreased ground-water withdrawals – water that is not injected does not need to be pumped. Rates of return flow injection were estimated by IDWR[21] (Appendix D, Exhibit 425). The original drain wells were estimated to have an aggregate "ballpark" injection capacity of approximately 240 cfs (based on 79 wells with an average capacity of 3 cfs)[22]. The 52 wells in 1993 were estimated to have a maximum discharge rate of 155 cfs (Bureau of Reclamation, 1993), with the peak of irrigation returns (155 cfs) occurring in July.

A&B has listed the cost for drain well rectification ($388,205) with costs associated with water level declines[23]. However, these costs were incurred as a result of environmental constraints, not water level declines, and should therefore not be included as well rectification.

3.4.2. Improved Irrigation Efficiency

Increases in irrigation efficiency have contributed to a reduction in ground-water demand, which should allow A&B to maintain adequate irrigation despite the historical decrease in annual diversion volumes. A&B reports that gravity-irrigated acres decreased from 81 percent of Unit B acres in 1980 to 4 percent of Unit B acres in 2007 (Exhibit 417). These percentages are based on the Unit B water-right area (64,930 acres) as of 1980 (Exhibit 405).

Irrigation system efficiency within the A&B Unit B area has increased as a result of conversion of gravity to sprinkler irrigation systems. The efficiency of traditional flood/furrow irrigation systems (supplied by siphon tubes or gated pipe) typically range from 30 to 40 percent, with efficiencies of 50 to 60 percent possible with careful management (Neibling, 1997). Sprinkler irrigation efficiencies range from 50 to 90 percent (Hubble Engineering and Associated Earth Sciences, 1991, Figure A-7). Furthermore, sprinkler irrigation systems enable improved crop yields (at least in most areas) and, in at least most cases, reduced farm labor requirements.

3.4.3. Reduced Conveyance Losses

The third reason that A&B has likely been able to deliver sufficient water despite a 9.7 percent decrease in annual system-wide withdrawals compared to previous years is increased conveyance efficiency. Conversions of gravity irrigation systems to

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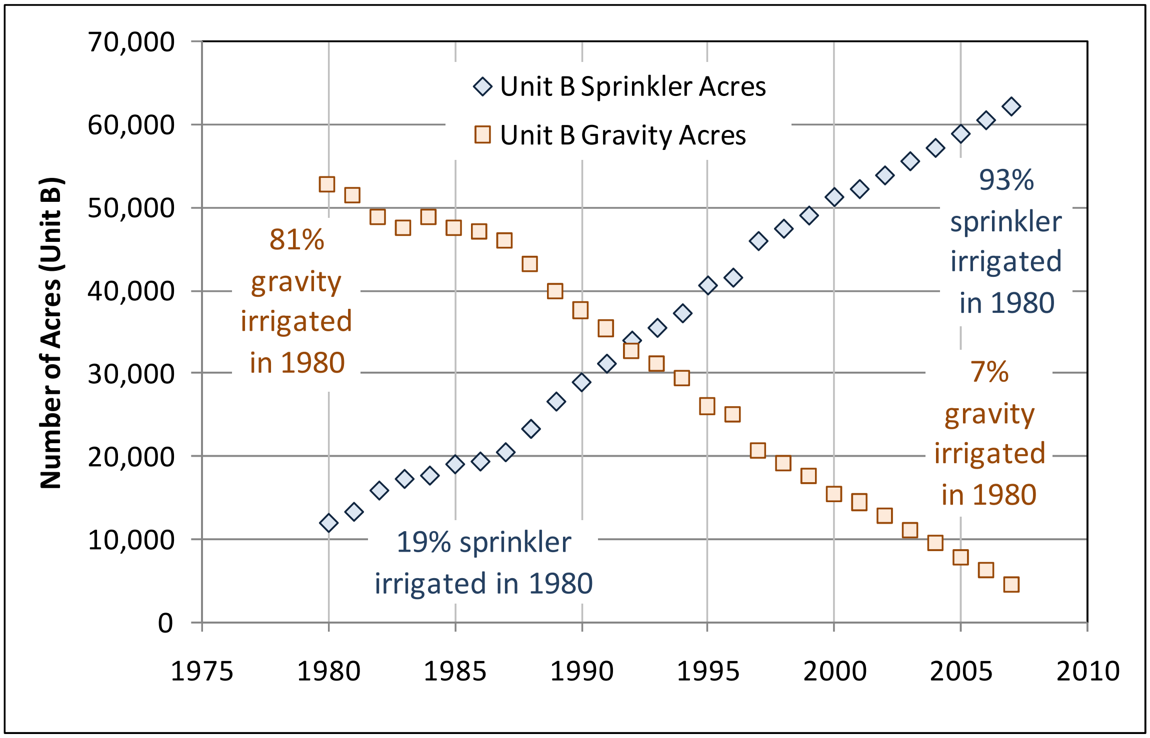
[20] Dan Temple deposition, June 24, 2008, pg 90, lines 14-20.

[21] "A&B_UIC_theo_calc.pdf" provided by Mathew Anders, IDWR, December 17, 2007.

[22] Mathew Anders, IDWR, email communication, December 17, 2007 (Appendix A, Exhibit 423)

[23] A&B Motion to Proceed, March 16, 2007, pg 6, lines 8-14.

sprinkler irrigation systems, lining or piping of open channels, and direct connections have led to a reduction of losses in the A&B conveyance system. A&B reports (based on GIS maps prepared by HDR Engineering, Inc.) that between 1960 and 2007 the aggregate length of laterals decreased from 276.8 miles to 116.4 miles of laterals (an open channel decrease of 58 percent) and 39.5 miles of pipeline in the A- and B-Units of A&B. The aggregate length of drains decreased from 368.7 to 196.4 miles (a decrease of 47 percent) over the same period. Thus, considering additional loss reductions from lining of open channels, the reduction in overall conveyance loss within the A&B system is probably more than 58 percent.



Data source: A&B data (Item D) Unit B Sprinkler Acres.xlsx

Exhibit 417: Acreage irrigated by gravity and sprinkler.

3.5. Duty of Water

A&B has claimed that the duty of water under water right 36-2080 should be 0.88 inches per acre, and that any delivery less than this amount represents injury[24]. Theoretically, an aggregate withdrawal rate of 1,100 cfs would provide 0.88 inches per originally-licensed acre (i.e., the 62,604.3 acres authorized under water right 36-

[24] *Dan Temple deposition, June 24, 2008, pg 53, lines 16-19.*

2080). However, through beneficial use claims and enlargements A&B now irrigates 66,686.2 acres. Thus, the District could deliver no more than 0.824 inches per acre if 1,100 cfs were evenly distributed over 66,686.2 acres. Deliveries less than 0.88 inches per acre therefore do not represent injury. Furthermore, deliveries of 0.824 inches per acre are greater than internal delivery standard established by A&B (i.e., 0.73 inches per acre prior to 1973 and 0.75 inches per acre since 1973).

Deliveries of 0.75, 0.824, and 0.88 inches per acre are substantially greater than the delivery rate of 5/8 (0.625) inch per acre established for other ESPA entities. An Amended Order (May 2, 2005) noted that the American Falls Reservoir District #2 and the North Side Canal Company define full headgate deliveries as 5/8 (0.625) inch per acre[25]. The Amended Order also noted that the full supply of water cannot be determined for A&B from the headgate delivery information provided by the other Surface Water Coalition Members[26] (likely because specific information for A&B had not been provided). Furthermore, the Hearing Officer in the Surface Water Coalition (SWC) delivery call found that "full headgate delivery for Twin Falls Canal Company should be calculated at 5/8 inch instead of ¾ inch" per acre[27].

3.6. Summary

A&B claims that "lands served by ground water diverted under A&B's right continue to suffer significant water shortages, seriously affecting the economic use and employment of farm land within A&B that receive irrigation water from the ESPA"[28]. It is possible that insufficient ground-water withdrawals could lead to (1) reductions in irrigated area (i.e., drying up of irrigated land), (2) a shift to lower-demand crops, (3) or reduced crop yields. However, no evidence has been provided that quantify reductions in irrigated acres or crop yields as a result of insufficient water, even in the most "water short" well systems. On the contrary, irrigated acreage has increased. The crop mix in Unit B is reported to be the same as in the surface-water irrigated Unit A, which is not water short. Furthermore, system-wide ground-water withdrawals have increased over the last 2 years, despite some ground-water decline.

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[25] *Amended Order in the Matter of Distribution of Water to Various Water Rights held by or for the Benefit of A&B irrigation District, American Falls Reservoir District #2, Burley Irrigation District, Milner Irrigation District, Minidoka Irrigation District, North Side Canal Company, and Twin Falls Canal Company, May 2, 2005, Finding of Fact 89, pg 19-20.*

[26] *Ibid, Finding of Fact 94, pg 20.*

[27] *In the Matter of Distribution of Water to Various Water Rights Held by or for the Benefit of A&B Irrigation Dist., American Falls Reservoir Dist. #2, Burley Irrigation Dist., Milner Irrigation Dist., Milner Irrigation Dist., Minidoka Irrigation Dist., North Side Canal Co., and Twin Falls Canal Co., Opinion Constituting Findings of Fact, Conclusions of Law and Recommendation, April 29, 2008 , page 53.*

[28] *A&B Motion to Proceed, March 16, 2007, pg 7.*

A&B has claimed that 0.88 inches per acre should be used as a delivery standard for water right 36-2080, and that deliveries of less 0.75 inches per acre is insufficient for growing crops. However, a delivery rate of 5/8 (0.625) inch per acre has been deemed appropriate for other irrigation entities (e.g., American Falls Reservoir District #2, the North Side Canal Company, and the Twin Falls Canal Company) with similar irrigation requirements.

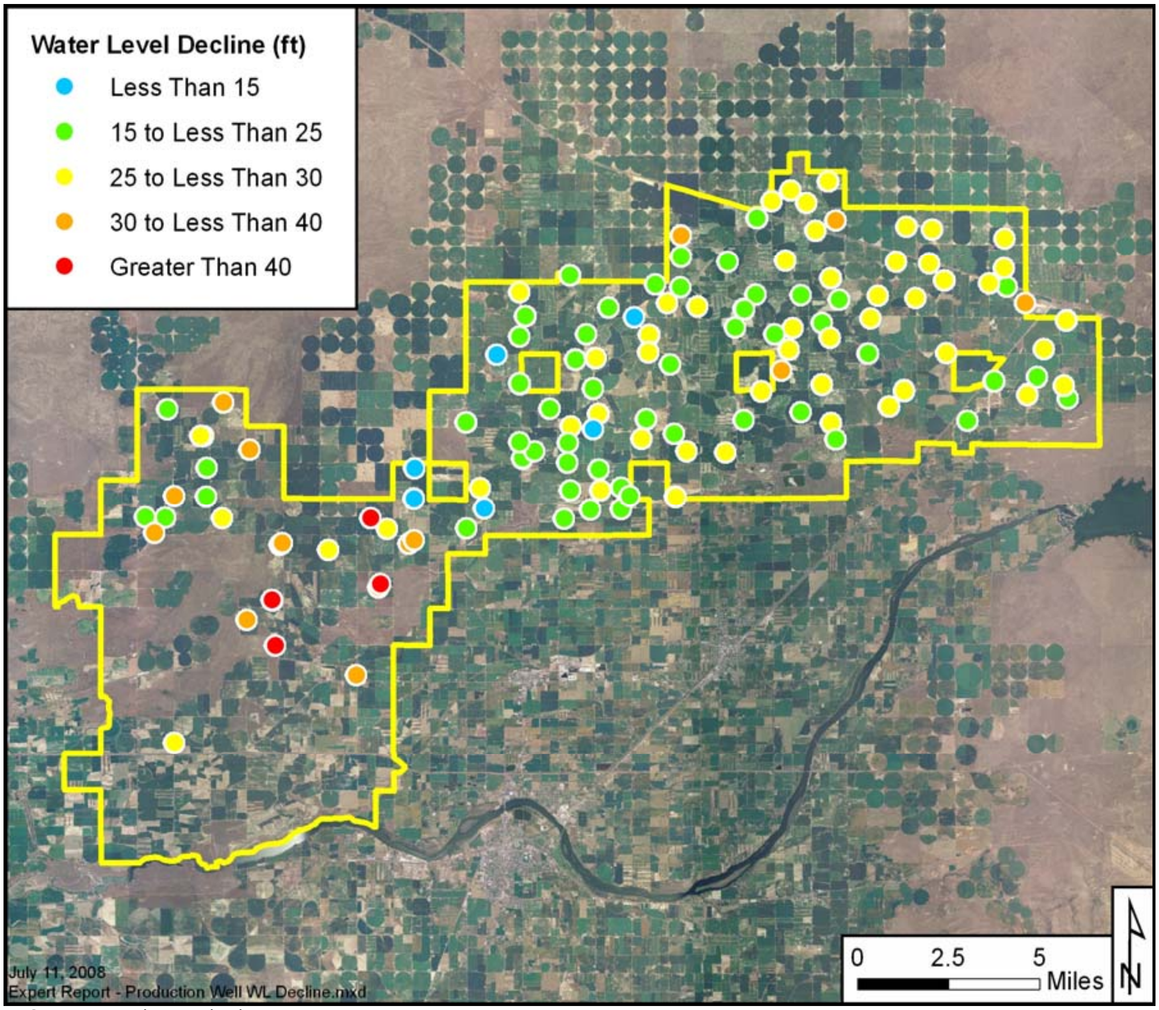
Sufficient delivery has been made possible by increased irrigation efficiency, increased conveyance efficiency, direct hookups from wells to irrigation systems, and abandonment of injection wells. Similar efficiency improvements have occurred throughout much of the Eastern Snake River Plain to improve water delivery to crops and reduce labor costs.

It would be possible to use additional wells to supplement well systems currently producing less than 0.75 inches per acre (if needed). Water right 36-2080 authorizes diversion from 188 wells (i.e., the water right lists 188 PODs with a ground-water source). It is curious that A&B appears to be diverting from only 175 wells. There is no hydrologic reason that A&B could not be using additional wells in most areas to supplement current deliveries.

Finally, it would be possible to move water from systems producing more than 0.824 inches per acre to those producing less than 0.75 inches per acre. Most of the A&B well systems are not currently interconnected. However, it would be possible to connect selected systems producing in excess of 0.82 inches per acre to distribution systems of at least some "water short" systems. It is interesting to note that the aggregate length of laterals and drains has been reduced by approximately 293 miles since 1960 – from approximately 646 miles in 1960 to 352 miles of laterals, pipelines, and drains in 2007 (in both the A- and B-Units). We are unable to determine to what extent the removal of conveyance capacity has limited the current ability of A&B to facilitate water movement from well systems producing more than 0.82 inches per acre to systems delivering less than 0.75 inches per acre.

4. GROUND-WATER LEVELS

Water-level declines have occurred in the A&B area, and most other areas in the ESPA. These declines, beginning in the 1950s, follow decades of ground-water level increases resulting from recharge resulting from surface-water irrigation[29]. A&B reports an average decline for all wells within the A&B system having a 1959-2006 data record of 25.7 feet, with a maximum of 45.5 feet and a minimum of 14.5 feet. The greatest water-level declines (greater than 40 feet) have occurred in the southwestern portion of the A&B area (Exhibit 418). The least declines (less than 15 feet) have occurred in the central portion of the A&B area.



Source: A&B (Item q data)

Exhibit 418: Distribution of water-level declines having occurred between 1959 and 2006.

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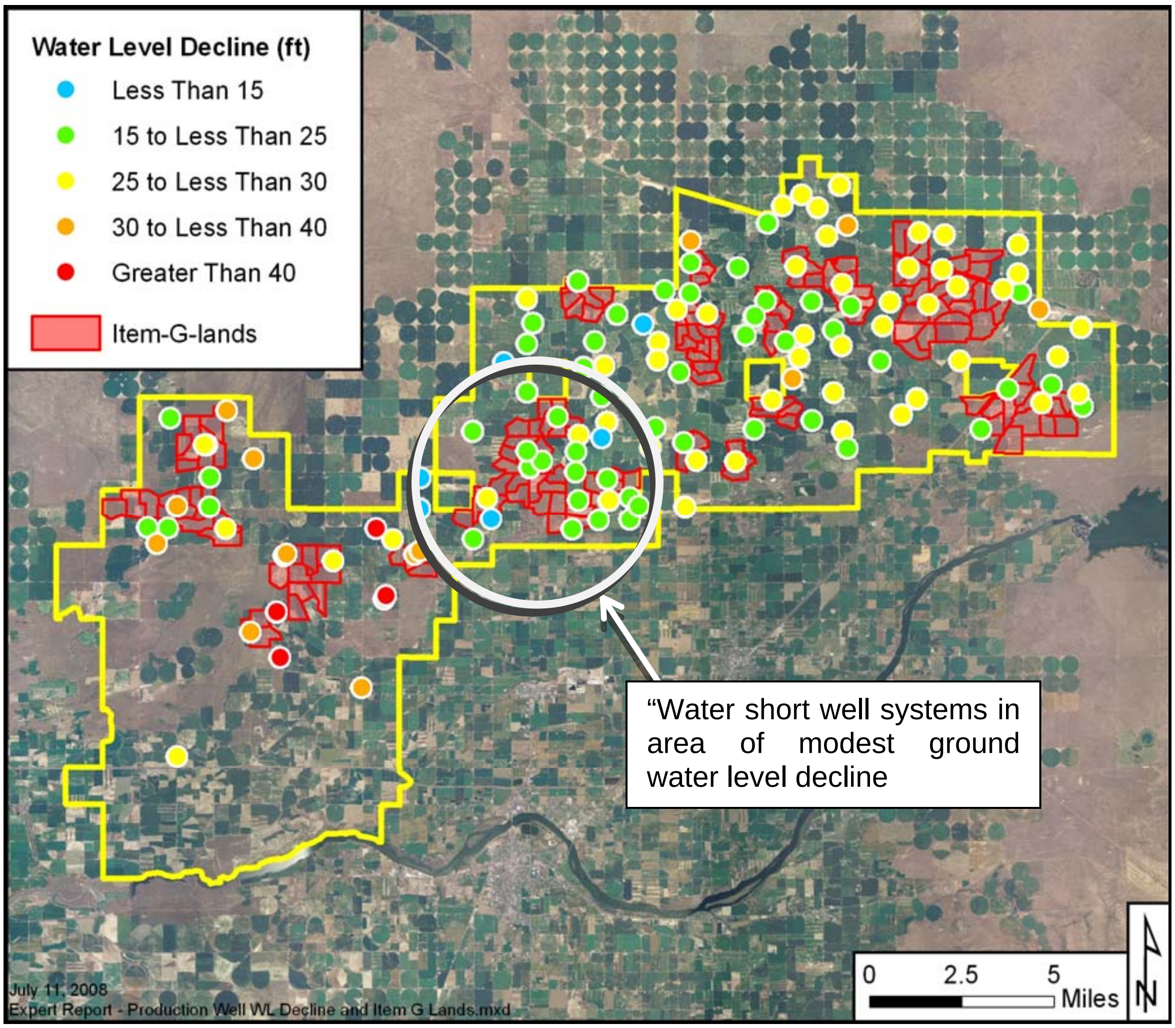
[29] *Please refer to testimony by Dr. Charles M. Brendecke regarding long-term water level trends.*

It is interesting that the area of least water-level declines (central area) occur in the center of the A&B service area. These water-level patterns reflect the heterogeneity of aquifer materials in the A&B area.

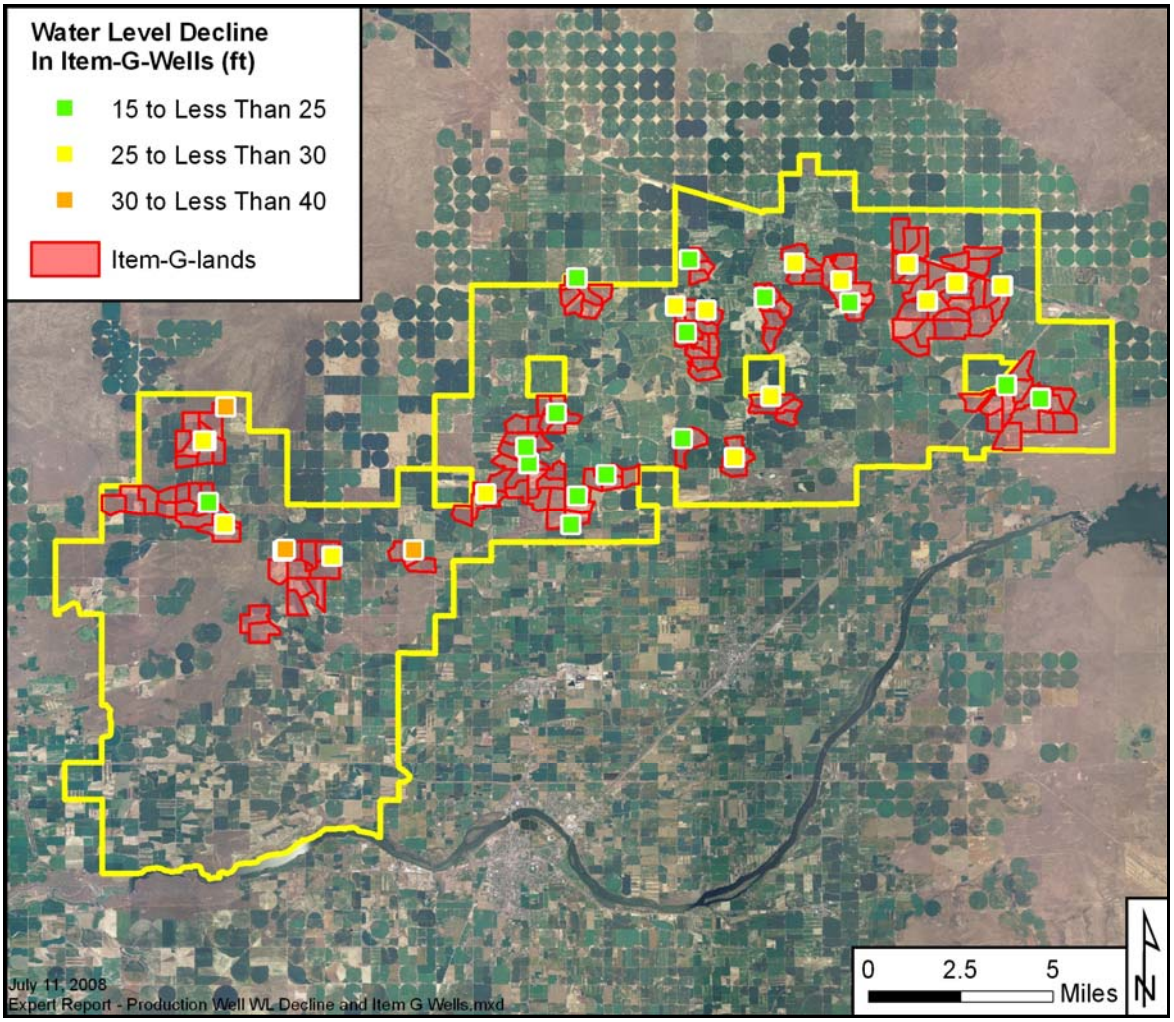
Some of the "water short" lands (referred to as "Item-g lands" in material supplied by A&B to IDWR)) are located in the vicinity of the least water-level declines. One example of this is shown in Exhibit 419.



Source: A&B (Item q data)

Exhibit 419: Distribution of water-level declines having occurred between 1959 and 2006 and "water short" (Item-g) lands.

Wells currently used in "water short" systems have not experienced the most extreme water-level declines – i.e., water-level declines greater than 40 feet (Exhibit 420). By inference, wells having experienced water-level declines in excess of 40 feet are either (1) delivering sufficient water, (2) have been abandoned, or (3) are being supplemented.



Source: A&B (Item q data)

Exhibit 420: Water level declines in “water short” wells and “water short” (Item-g) lands.

Many hydrographs provided by A&B show a consistent pattern of declining and rising water levels. Water levels declined from about the mid-1950s into the mid-1960s, rose into the mid-1970s, declined into the early 1980s, rose into the mid 1980s, declined into the mid-1990s, rose until the early 2000s, and declined from about 2000 through 2006.

4.1. Reasons for Water-Level Declines

Reasons for the general ground-water level decline observed in many A&B wells include the effects of drought, reduced recharge resulting from the conversion of gravity to sprinkler irrigation systems throughout the ESPA, and ground-water pumping.

Ground-water levels in the ESPA rose from the late 1800s into the 1950s in response to incidental recharge from surface-water irrigation activities. Following a general water-level peak in the 1950s, water levels declined from 1 to 36 feet – and an average of approximately 12 feet – from the mid-1950s through the mid-1960s (Bureau of Reclamation, 1985). Ground-water Geologist Jack Frink attributed 6 to 7 feet of the average decline to irrigation pumping and the remainder to a drier climatic period (Bureau of Reclamation, 1985). This period – mid-1950s through mid-1960s – coincided with the development of A&B wells and nearby private rights.

A wetter climatic period from the mid-1960s to the mid-1970s led to a recovery of an estimated 5 feet of the average 12-foot decline observed in the mid-1950s through mid-1960s (Bureau of Reclamation, 1985). However, another declining period from the 1970s through about 1982 resulted in a net decline of 10 to 15 feet between the 1950s and 1982. These latter declines were attributed to

> "(1) a drier climatic trend in the 1950's to 1960's and 1970's to 1980's; (2) additional ground-water pumping throughout the Snake Plain aquifer area, with over 400,000 acre-feet in the area adjacent to the North Side Pumping Division [A&B Unit B]; (3) reduced wintertime diversions beginning in the early 1970's; (4) reduced irrigation diversions in the Minidoka Irrigation District resulting from water savings practiced by the irrigators; (5) increased pumping in some of the North Side Pumping Division aquifer recharge areas such as the Northwest Raft River and Northern Oakley Fan" (Bureau of Reclamation, 1985)

Some of the ground-water level declines experienced in A&B wells – especially those in the southwestern portion – reflect local hydrogeologic constraints. For example, some of the wells in the southwestern portion of the A&B area penetrate substantial thicknesses of sand and clay sediments. The Bureau of Reclamation noted that

> "where flow sheets are made up of dense and massive basalt and/or is covered, penetrated, or interbedded with fine sediment, the water yield is small to moderate. One such area is the southwest part of Unit B located mostly in T9S/R22E where several low yielding wells are found" (Bureau of Reclamation, 1985).

In addition, reduced injection from A&B drainage wells and reduced seepage from A&B conveyance channels have contributed to decreased local recharge. The amount of injection, while unknown, could have been 10 percent or more of the 1,100 cfs rate authorized under water right 36-2080.

In general, a well drawing water from a saturated zone containing substantial amounts of sediment will likely have a greater drawdown at a given discharge rate than wells drawing water at the same rate but completed in the highly-fractured ESPA basalt. Wholesale curtailment of junior-priority ground-water users throughout the ESPA would not improve the water-bearing characteristics of these sediment zones.

Finally, the minimum long-term water-level declines observed in the A&B area in wells having a 1959-2006 record is about 14.5 feet. Based on numerical simulations, approximately 1/3 of the decline has been caused by drought, 1/3 by reduced incidental recharge resulting from irrigation system conversions, and 1/3 from ground-water pumping[30]. The magnitude of impact from junior pumpers in the greater ESPA can therefore not be more than a portion (e.g., 1/3) of the minimum local declines observed in the A&B area.

4.2. A Return to Historic Ground-Water Levels is not Possible

A&B is requesting that water levels be restored to historical levels through administration (e.g., curtailment of junior pumpers) or be compensated for "the expense of deepening the wells of A&B to pump the amount of water to which A&B is entitled to pump at a lower level and will pay the additional expense that will be incurred in pumping from a lower water table"[31].

Ground-water levels in the A&B area have clearly declined since the 1950s. Approximately 1/3 of the ground-water level decline has been attributed to ground-water pumping[32]. Thus, an average of approximately 8.5 feet of an average decline of 25.7 feet experienced in A&B wells might be attributed to ground-water pumping under *both* senior and junior rights. To put this into context, water levels in the A&B area had declined more than this 9-foot amount by the mid 1960s because of pumping and drought conditions (Bureau of Reclamation, 1985).

Curtailment of junior-priority pumping would address only one of the reasons for ground-water level declines in the A&B area – that of ground-water withdrawals. High ESPA water levels in the late 1940s and early 1950s resulted, in part, from decades of incidental recharge from inefficient gravity irrigation systems. Thus, curtailment will not restore water levels to anywhere near 1950s or 1960s levels – even if all ground-water pumping (including that of A&B) is curtailed. Furthermore, aquifer heterogeneity makes it difficult to predict where and in what form potential water level responses from curtailment would occur.

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[30] *Alan Wylie deposition, May 19, 2008, pg 106, lines 16-19.*

[31] *A&B response to IGWA's first interrogatory and second Request for Production, February 21, 2008, Interrogatory No. 9, pg 8*

[32] *Alan Wylie deposition, May 19, 2008, pg 106, lines 16-19.*

Full restoration of historical ground-water levels will not be possible without re-converting surface-water irrigated lands inside and outside of A&B from sprinkler to gravity irrigation systems. Curtailment alone – even if all ground-water pumping were curtailed – would not restore 1950s water levels. Instead, roughly 1/3 of the ground-water level decline would persist because of increased efficiency on surface water irrigated lands, and another 1/3 of the ground-water level decline would persist if drought conditions continue. Furthermore, a significant portion of the water-level decline within A&B has been caused by A&B pumping (as evidenced by the decline in the 1950s and 1960s). Thus, curtailing all groundwater pumping junior to A&B on the ESPA is likely to restore less than 1/3 of the historical water-level decline.

4.3. Reasons to Expect Water-Level Stabilization

There are several reasons to believe that recent ground-water level declines will moderate and stabilize in the future:

- A moratorium on the processing and approval of pending and new applications for permits to appropriate water from surface- and ground-water sources within the ESPA went into effect on May 15, 1992. Thus, new ground-water pumping is not coming on line, and effects from pre-1990 pumping should be equilibrating.
- A large portion of the possible conversions from gravity to sprinkler irrigation systems in the ESPA have already occurred. Based on model simulations, the ESPA reaches a new hydraulic equilibrium after an approximate 20-year timeframe. It is therefore likely that the response to past conversions – especially in the A&B vicinity – will begin to reach equilibrium conditions.
- Improvements in irrigation efficiency are often associated with reductions in ground-water withdrawals. Reduced ground-water withdrawals will contribute to stabilizing ground-water levels.
- Drought conditions led to ground-water level declines in the late 1950s to early 1960s, late 1970s, late 1980s to early 1990s, and the early to mid 2000s. Undulating hydrograph patterns reflect alternating dry and wet year conditions – water levels decrease following dry years and increase following wet years. It is likely that the downward water-level trend will moderate and reverse as drought conditions moderate.
- Current water administration will contribute to stabilization of ground-water levels. The current estimated ground-water pumping accounts for approximately 2 million acre feet of the estimated 7.5 million acre feet to annual aquifer recharge. The balance becomes aquifer discharge to the Snake River (such as in the Thousand Springs reach). Measures are being undertaken to increase spring flows that will have a stabilizing influence on the ESPA.

- Finally, much attention is being focused on developing additional measures that will help stabilize water-level declines in the ESPA. Development of a Comprehensive Aquifer Management Plan (CAMP) will likely lead to measures that will increase water supplies for both surface and ground-water users.

4.4. Summary

Water-level declines have occurred in the A&B area as a result of (1) conversions from flood irrigation to sprinkler irrigation methods throughout the ESPA, (2) drought conditions, and (3) ground-water pumping. In addition, A&B's reduced injection of return flows and reduced seepage because of surface channel lining (or replacement with pipes) has likely contributed to declines, at least on a local basis.

Some declines were observed in the late 1950s and early 1960s to which local pumping likely contributed. IDWR personnel[33] have testified that each of these three influences is responsible for approximately one third of the local ground-water level declines. Declines have been exacerbated in portions of the A&B area (e.g., southwestern portion) as a result of local hydrogeologic constraints.

The minimum long-term water-level decline observed in the A&B area in wells having a 1959-2006 record is about 14.5 feet. The magnitude of impact from junior pumpers in the greater ESPA cannot be more than a portion (e.g., 1/3) of the minimum local declines observed in the A&B area.

The approximate portion of decline associated with pumping (e.g. 1/3 of the average 25-foot decline observed in the A&B area) is modest in the context of full beneficial use of the aquifer. No information has been provided that suggests that this portion of the general ground-water level decline – approximately 8.5 feet – has made irrigation infeasible inside or near the A&B area.

It is not possible to restore ground water levels to those observed in the 1950s through curtailment of junior-priority users. Full restoration would require re-conversion of sprinkler-irrigated lands to gravity systems.

Finally, there are several reasons to anticipate moderating ground-water level declines (or even increases) in the future, including the following:

1. Effects of conversions of gravity to sprinkler irrigation will equilibrate
2. Reduced ground-water withdrawals in response to increased efficiency
3. A likely eventual end to drought conditions
4. Water administration aimed at maintaining and restoring discharge in the Thousand Springs reach will contribute to stabilizing ground-water levels.

[33] *Alan Wylie deposition, May 19, 2008, pg 106, lines 16-19.*

5. Additional measures such as those being developed in the CAMP process.

5. WELLS

5.1. Abandonments and Replacements

A&B claims to have made major investments in infrastructure and efficiency improvements (e.g. pump and pipe distribution systems, well replacements, increased pump motor sizes, altered conveyance systems, decreased conveyance losses, etc.) to "remain viable with the shortage caused by declining ground-water levels"[34].

The numbers of wells drilled, re-drilled, and deepened were reviewed in Section 2.2. Many of the 104 second drills, 22 third drills, and 4 fourth drills (Exhibit 402) occurred prior to 1965 (Exhibit 403 and Exhibit 404). The number of wells drilled or re-drilled since 1994 - an average of 1.8 wells per year, or 1 percent of the total A&B wells – is modest, especially given that many of the project wells have been in service for over 5 decades. The current deepening and replacement numbers are also small compared to the number of wells that were re-drilled prior to 1965 (an average of almost 5 wells per year).

Initial wells were drilled by cable-tool methods to a depth where drill cuttings were lost – taken as an indication of good yield. Casing was installed in sedimentary intervals if caving occurred; the liner would be perforated if cased within a "good" aquifer section (Bureau of Reclamation, 1985). After completion, a pump test would be run to determine well yield; if insufficient, the well would be deepened.

The Bureau of Reclamation notes (1985) that these "methods were workable, but generally did not allow for much lowering of the pump if the water level declined." Unfortunately, the project began at a period of peak water levels. Declining water levels in the late 1950s and early 1960s required deepening of many wells (Exhibit 402 through Exhibit 404). Declining water levels were predicted in 1956: "sustained heavy pumping in the North Side Pumping Division and adjacent areas probably will cause low-order regional lowering of water levels" (Crosthwaite and Scott, 1956).

A&B notes that 7 wells have been abandoned since 1980, and mostly since 1994, to "remain viable with the shortage caused by declining ground water levels"[35]. A&B provided data for 11 wells that were abandoned over the entire project history. A cursory review of records for the abandoned wells provided the following insight:

1. 15B825 was abandoned because the hole was too crooked to allow the pump to be set deeper. The replacement well (15C825) was drilled to the same depth (250 feet). The well appears to have been abandoned in 2007.

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[34] *A&B Motion to Proceed, March 16, 2007, pg 5.*
[35] *Ibid.*

2. 07B824 was abandoned in August 2000 for environmental purposes because a submersible pump with a mercury seal broke, spilling mercury into the well. The well was apparently plugged to isolate the contamination.
3. 26A823 was reportedly relocated to accommodate a water user. It appears that the use of the well was discontinued between 2000 and 2005, but water-level measurements are available through 2006.
4. 10B823 was reportedly abandoned (with production shifted to another well) to accommodate a water user in 2005.
5. 09A922 was replaced due to “insufficient water” (it appears to have been abandoned in 2004). However, notes in the maintenance log shows drilling problems associated with (1) caving of sedimentary materials and (2) an improperly installed liner that prevented deepening of the well and resulted in needing to set the pump shallower. For all practical purposes, the attempt to deepen the well resulted in a well failure as a result of well construction problems. Use of this well was discontinued sometime between 1995 and 2000.
6. 03A1022 has no information in the file to show why the well was abandoned (abandoned sometime after 1995).
7. 11A922 was reportedly converted from a production well to an injection well. After being used as an injection well, an attempt was made to convert it back to a production well without success. It is possible that use of the well for injection resulted in plugging of the aquifer in the vicinity of the well bore. The abandonment date is unclear.
8. 10A922 has no information in the file to show why the well was abandoned, but was likely abandoned because the pump could not be set deeper due to a 12-inch liner pipe (i.e., well construction issue). It appears that the well may have been abandoned in 2005, although use of the well may have been discontinued earlier.
9. 33C922 has no information in the file to show why the well was abandoned. The well was abandoned sometime after 1990.
10. 20A922 has no file; use appears to have discontinued between 2000 and 2005.
11. 22A922 has no file; it appears that the well may have been abandoned in 1995.

Thus, of the 11 abandoned wells, 3 were abandoned because of well construction problems, 2 wells were relocated for the convenience of a water user, 1 well was abandoned for environmental reasons, and 1 well may have been abandoned because of formation plugging. Reasons for abandoning the remaining 4 wells are unclear, but may have been abandoned for reasons associated with declining water levels.

Eight wells within A&B are "new wells", constructed or purchased since the original A&B wells were drilled prior to 1964. All eight of the wells were drilled or purchased since 1993. Six wells were drilled to replace wells that were abandoned for the various reasons described above. Two wells (1 drilled well and 1 one purchased well) were for purposes of supplementing deficient systems. Out of more than 180 wells in the A&B system, only 2 wells were drilled or purchased since 1964 for the sole purpose of increasing the water supply not associated with an abandoned well.

Water right 36-2080 lists 188 points of diversion for a ground-water source. The right appears to have been licensed with 177 wells. A&B data indicate that there currently are 175 active wells.

Nearly all A&B wells have apparently been able to obtain adequate production from zones between 200 and 500 feet. Four wells out of more than 180 wells have been drilled or deepened to below 600 feet. Two of these four wells were subsequently abandoned, but there is no information available on these wells (maintenance logs are missing) to indicate why they were abandoned.

When wells have been deepened, they generally have been deepened to the minimum depth necessary. For example,

1. Of the 83 wells that have been deepened only once, the average depth per deepening was only 61 feet.
2. Of the 19 wells that have been deepened twice, the average depth per deepening was only 50 feet.
3. Of the 3 wells that have been deepened three times, the average depth per deepening was 82 feet.

Given the apparent declines that occurred from the onset of production within A&B, it is surprising that wells were not commonly deepened to greater depth. Alternatively, it can be argued that the first deepening was adequate in more than 80 percent of the 105 wells that have been deepened.

It is interesting that none of the original USBR specifications for A&B wells listed in the USBR "Blue Books" appear to be written to allow significant water development from the sediments. This is not a criticism of the specifications, but rather recognition that the engineers that designed the wells realized that the wells could be constructed most economically if they were designed to tap permeable basalt zones rather than constructing more expensive gravel-packed wells to develop water from sediments.

The primary drilling method used by A&B – cable tool – was appropriate for developing water from fractured basalt zones. However, judging by the number of deepenings over time, the target depth (a matter of design and construction, not drilling method) was insufficient for many of the original wells.

The well construction techniques (i.e., cable-tool drilled open boreholes with liner pipe) utilized within A&B do not provide a means of coping with sand production other than to install blank liner opposite sand zones. It is possible that some wells could produce more water if constructed to develop water from sands (if present) using filter packs and well screens.

5.2. Costs

A&B claims that well rectification costs averaged $152,000 per year in 1995 through 2005 (A&B Motion to Proceed). Furthermore, costs for drain well rectification and reductions in operational waste to increase water supplies in 2002 through 2005 averaged $388,205 per year. A&B also states that it expended “an additional $2.476 million in well rectification consisting of increasing horsepower, retrofitting pumps and bowls, and deepening wells, in the District’s chase to ground water that exists at lower levels, resulting in an additional cost averaging nearly $206,000 per year, over and above normal operation and maintenance of the well system”[36]. It is unclear to what extent some of these costs may be overlapping.

On a per-acre basis, these costs range from $2.28 to $5.82 per acre (Exhibit 421). By contrast, the annual A&B assessments for general operating expenses (including rectification) are $70 per acre[37]. Furthermore, the drain well rectification (contributing to the $5.82 per acre cost between 2002 and 2005) was done for water quality purposes (Bureau of Reclamation, 1993) and should not be considered as rectification for declining water levels.

Purpose	Period	Period (years)	Amount per year	Amount per acre(4)
Well rectification(1)	1995-2005	11	$ 152,000	$ 2.28
Drain well rectification and reductions in operational waste(2)	2002-2005	4	$ 388,205	$ 5.82
Well rectification(3)	1998-2007	10	$ 206,000	$ 3.09

Notes:
(1) Source: A&B Motion to Proceed, March 16, 2007
(2) Source: A&B Motion to Proceed, March 16, 2007
(3) Source: Affadavit of Dan Temple in support of A&B’s motion for Declaratory Ruling, March 21, 2008
(4) Based on 66,686 authorized acres

Exhibit 421: Reported well rectification costs.

[36] *Affidavit of Dan Temple in support of A&B’s motion for Declaratory Ruling, March 21, 2008, pg 6.*

[37] *Dan Temple deposition, June 25, 2008, pg 356, line 2.*

5.3. Summary

On average, A&B has deepened or replaced 1.8 wells per year since 1994. This represents approximately 1% of the total authorized points of diversion. Although production from the A&B wells has been impacted by water-level declines since the late 1950s, very few wells have been drilled since 1965 to maintain the supply. Surprisingly, it does not appear that A&B has drilled additional wells to supplement the water supply in "water short" well systems.

During 1995 through 2005, A&B claims that well rectification costs averaged $152,000 per year and between 1998 through 2007 incurred an average annual cost of $206,000 per year, over and above normal operation and maintenance of the well system. These costs are equivalent to annual per-acre costs ranging from about $2.28 to $5.82 per acre.

Finally, A&B has testified that all well replacement costs and costs associated with sand production are considered "rectification" for water-level declines. Declining water levels have required well deepenings, pump changes, and other measures. However, not all rectification efforts have been required by decreasing water levels. Poor well construction, wells of insufficient depth, sand caving, etc. are not necessarily the result of water-level declines. Costs for drain well rectification appear to have been required for water quality reasons, and were therefore not necessarily expended in response to declining water levels. A detailed examination/audit is likely warranted to determine costs truly associated with water-level declines. Furthermore, only a portion of costs associated with water-level declines could be attributed to impacts associated with the junior pumping.

6. USE OF GROUND-WATER MODEL

6.1. Introduction

The Enhanced Snake River Aquifer Model (ESPAM) has been developed by the Idaho Water Resources Research Institute (IWRRI) to, in part, "estimate impacts between ground-water use and surface-water resources to support water management decisions" (Cosgrove et al., 2006). Various scenarios have been simulated with the model, including a scenario estimating relative withdrawals in the A&B area (Wylie, May 2005).

6.2. General Concerns

A&B maintains that the ESPA ground-water model can provide "technical information that will be useful to the Director in meeting his obligation to deliver water to senior appropriators" (A&B Irrigation District, March 19, 2007). There are, however, several factors limiting the use of the aquifer model in the way that A&B suggests.

First, the ESPA model is a single-layer model simulating ground-water flow in a horizontal plane. The A&B service area is underlain by multiple, discrete aquifer zones, likely with vertical hydraulic gradients (and therefore likely vertical flow). The ESPA model does not simulate vertical flow in the stratified aquifer system underlying A&B, and therefore may not suitable for evaluating local ground-water flow (and administration) issues.

Second, the one-mile uniform grids may be inadequate to simulate the local variability present in the A&B area – especially in the southwestern area where wells penetrate Burley Lake sediments. Local-scale variability is relevant because administration scenarios could include simulating the effects of potential curtailment of junior-priority wells within A&B lands.

Third, the ESPA model was calibrated using the PEST automated parameter estimation tool (Cosgrove et al., 2006). Tools allowing for the numerical quantification of parameter uncertainty associated with predictive simulations (Doherty, 2000) are available and should be considered for evaluating parameter uncertainty associated with the A&B scenario. These tools would allow quantification of uncertainty associated with model predictions. Quantification of uncertainty is important for evaluating whether the model output is sufficiently reliable to use as a basis for management decisions.

6.3. A&B Scenario

The scenario was intended, in part, to "provide technical information that will be useful in the resolution of conflicts among water users and in future water administration" (Wylie, May 2005). However, IDWR recognizes that the "scenarios, such as the A&B

Scenario, are not intended for use in administering the State of Idaho's water"[38]. Although providing insight, the scenario provides a very incomplete basis for water administration. The "pumping of others" includes the entire ESPA and private water users within A&B. It also includes pumping for expansion lands within A&B. The scenario does not predict to what point water levels might rise if IDWR were to curtail junior-priority withdrawals, and how long it might take to do so.

6.4. Summary

The A&B scenario does not in and of itself provide a basis for water administration. The scenario does not distinguish among various water rights, does not evaluate ground water level responses to a potential priority call, and does not consider various other factors influencing ground water levels in the A&B area.

[38] *IDWR Order, January 29, 2008, Finding of Fact 122.*

7. CONCLUSIONS

The following conclusions can be drawn from a review of information and data pertinent to the A&B delivery call:

1. Diversion of less than 1,100 cfs and 250,417.2 acre feet per year has been sufficient for the intended beneficial use under water right 36-2080 and does not represent injury.
2. No evidence has been provided quantifying fallow acreage, a shift to lower-demand crops, or reduced crop yields. On the contrary, irrigated acreage has increased and crops grown in the B-Unit are the same as the surface-water irrigated A-unit. Based on the evidence provided, the A&B Irrigation District is not water short.
3. Sufficient delivery – despite withdrawal less than the maximum amounts authorized under water right 36-2080 – has been made possible by increased irrigation efficiency, increased conveyance efficiency, direct hookups from wells to irrigation systems, and abandonment of injection wells. Similar efficiency improvements have occurred throughout much of the Eastern Snake River Plain to improve water delivery to crops and reduce labor costs.
4. A&B uses an internal delivery standard of 0.75 inches per acre. However, a delivery rate of 5/8 (0.625) inch per acre has been deemed appropriate for other nearby irrigation entities (e.g., American Falls Reservoir District #2, the North Side Canal Company, and the Twin Falls Canal Company) with similar irrigation requirements.
5. Additional wells and interconnection of existing wells could be used to supplement well systems currently producing less than 0.75 inches per acre (if supplementation is needed). Water right 36-2080 authorizes diversion from 188 wells; A&B lists 175 currently active wells.
6. Well systems producing less than 0.75 inches per acre are generally located adjacent to or in the general vicinity of well systems producing more than this amount. It would be possible to move water from systems capable of higher diversion rates to "water short" systems or to specific land within "water short" well systems.
7. Water levels in the A&B area have declined as a result of (1) conversions from flood irrigation to sprinkler irrigation methods throughout the ESPA, (2) drought conditions, and (3) ground-water pumping.
8. It is not feasible to restore ground water levels to those observed in the 1950s through curtailment of junior-priority users because a return to 1950s water levels would require a return to flood irrigation and elimination of Palisades storage.

9. On average, A&B has deepened or replaced 1.8 wells per year since 1994. This is a modest number for a well-based water system of this size.
10. The reported rectification costs should be viewed in the context of system size. For example, the costs of $152,000 per year from 1995 to 2005 and the more recent annual cost of $206,000, when averaged over 66,686.2 acres, is equivalent to approximately $2.28 and $3.09 per acre, respectively. This compares with the current $70 per acre annual assessment cost for A&B members.
11. The A&B scenario does not in and of itself provide a basis for water administration. The scenario does not distinguish among various water rights, does not evaluate ground water level responses to a potential priority call, and does not consider various other factors influencing ground water levels in the A&B area.

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